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JUNE 1982

Vol1 No6

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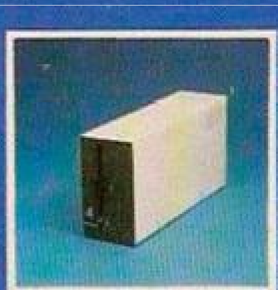
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EDITORIAL

THE SPECTRUM'S arrival on the microcomputing front line will decimate the ranks of prospective Vic, BBC Micro and Atom users, but will the ZX-81 be its first victim? Undoubtedly even before their expectant fingers have had a chance to grapple with the Spectrum's complex shift-key system, many ZX-81 owners will find the prospect of low-cost colour, sound and memory a lure too strong to resist. But with substantial ZX-81 price reductions in the air — £50 for the basic machine — the 81 will still be in a very strong position to offer the young or the penurious beginner an ideal point of departure into computing.

Some of the 180-odd companies which have sprung up to service the ZX-81 with software, hardware and peripherals have already reported a drop in trade since Sinclair announced his new colour computer. ZX users are clearly waiting for a sight of the new micro before deciding to shell out more on expanding their existing systems. But the attractions of the Spectrum will reach out beyond current micro owners to those who decided against making the ZX-81 their first machine when they saw its flickering screen and heard about its capricious loading.

The Vic was aimed at those first-time users. Now one can only speculate on what Commodore's response will be to Sinclair's latest venture: it will have to be strong if it is to save the Vic-20 from an ignominious end to a brief career. At £180-plus for a 2.5K low-resolution colour computer, the Vic has overnight became a radically less attractive proposition when compared with the £175 needed to secure a 48K high-resolution Spectrum. Drastic price cuts seem the only answer. Commodore's £100 Ultimax might have had some say in the matter, if it had not been shelved for the immediate future.

In any case the Spectrum will not have it all its own way. The BBC Micro, despite its higher price, still has features that Sinclair's colour micro cannot rival — a real keyboard, sound synthesiser and composite video, for example. Furthermore the Electron, Acorn's still-secret weapon, could present the Spectrum with some very tough competition.

Perhaps the last variable in the micromarket equation is Sinclair's Microdrive. Coupled with the power of the Spectrum, the appeal of 100K mass storage for £50 may add up to a renewed period of the Sinclair domination which started with the announcement of the ZX-80 in January 1980.

The projected new price for the ZX-81 is £80 with the 16K RAM pack. That should be enough to ensure steady sales in the U.K., and continued success worldwide. At the same time, the cost of the ZX printer has discreetly risen to about £70. Sinclair has made it clear that he will not stop ZX-81 production. In any case, unlike programs loaded into a wobbly RAM pack, the 350,000 ZX-81s already sold will not just vanish into thin air. ■

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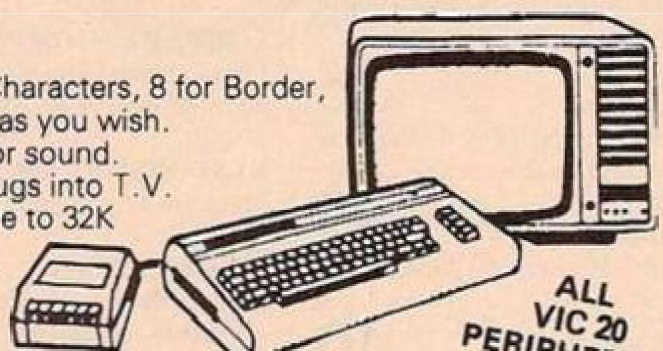
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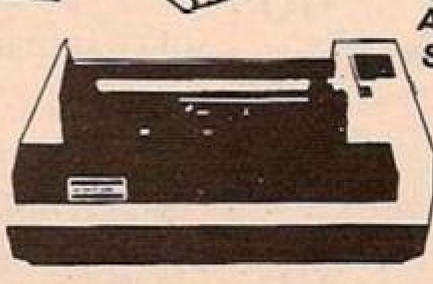
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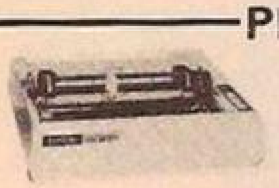
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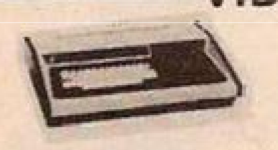
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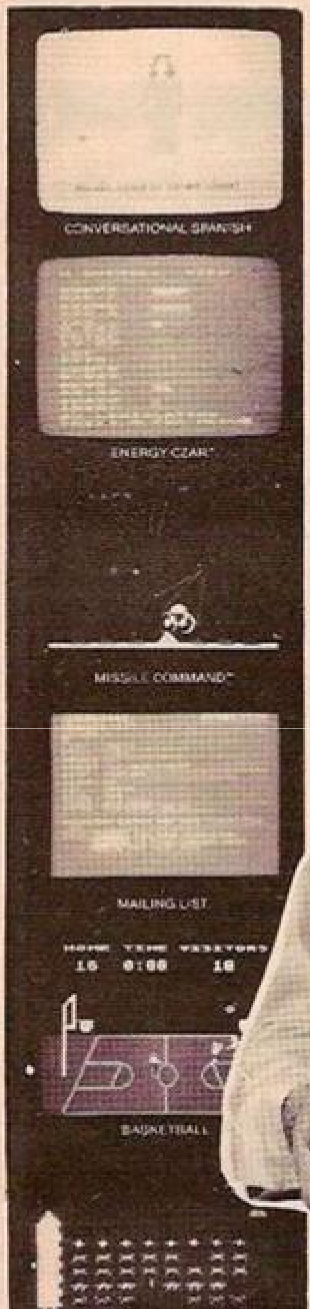
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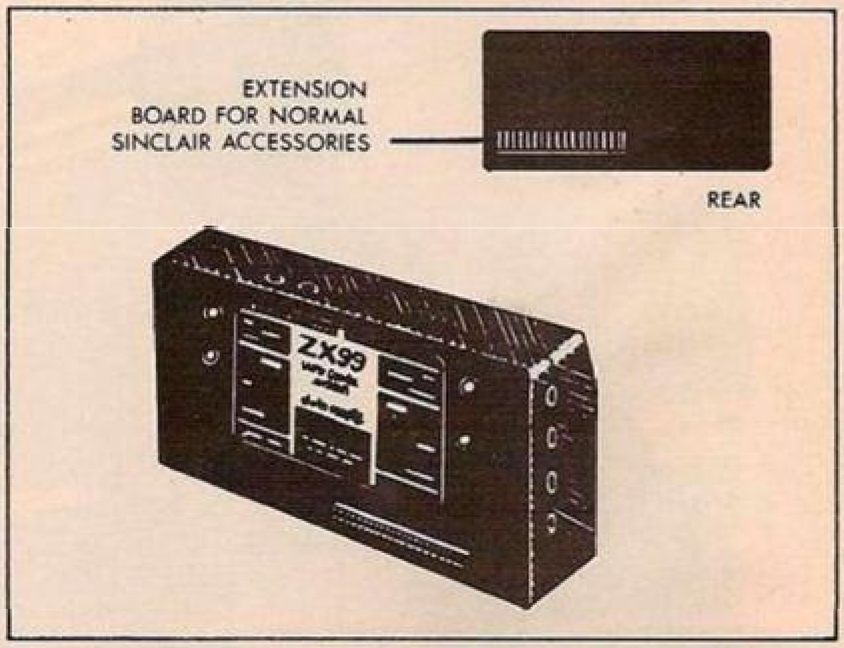
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YOUR LETTERS

UNBEATABLE LOSER

Tony Poulter claims his noughts and crosses program, in February's *Your Computer*, is unbeatable. This is only true if you play logically. If you play X and arrive at this position:

```
0 0 3
5 × 7
9 × B
```

by playing 6, then A, your logical move is 3 to block the computer's winning line, but play 9 instead and the computer ignores the chance to win and tries to block you by playing B, leaving you to win with 3.

Paul Blythe's Brahma in April's *Your Computer* works on the ZX-81 1K but only by changing line 140 to:

```
LET A(D,E-1)=A(C,B)
```

to stop rings disappearing. Also, you do not need extra memory to have more rings. By replacing all numbers in with Code"Chr$n" except for 0, 1 and 3 which can become Sin Pi, Sgn Pi and Int Pi and renumbering lines 70, 75, 80 as 61, 62 and 63 you can have up to nine rings with room to make an illegal move or two.

Jack Betteridge's Prime Numbers program in April's *Your Computer* has a misprint in line 200 which should be:

```
IF P=0 THEN GOTO 250
```

Line 110 can be changed to:

```
IF C<> Y THEN GOTO 140
```

It also needs some changes to run on the ZX-81:

```
150 IF A=INT (A/2)*2
    THEN LET A=A+1
160 FOR Y = A TO B STEP 2
180 LET R = INT (Y/Q)
Delete 250
```

To stop 1 being reprinted when A=1, add:

```
145 IF A=1 THEN LET A=2
```

Although mentioned in the Sinclair manual on page 74, I have not seen a Software File program using Goto as a conditional expression. One could be used in B T Jeeves's Satellite Plot, April, making the following changes: Delete lines 50, 60, 70, 100.

```
55 CLS
65 GOTO (10 AND A<>1 AND
   A<>2)+(75 AND A=1)+
   (105 AND A=2)
```

K Feary,
Wendover,
Buckinghamshire.

PORT POINTS

With reference to Stephen Adams' recent review of ZX-81 Ports, we would like to clarify the following points concerning our 16K RAM and I/O board. Our board is usually supplied complete with 0.5A power unit for £53, but is available without for users who already have a suitable unit. The board will not work without a separate power-supply unit as its +5V and -5V are derived on board from the 12V. Data sheets for the 8255 cost 50p with the board or 60p separately. General data will be sent on receipt of a stamped, addressed envelope.

The edge connector is included in the price, although we can supply it separately for £3.20. The kit is not available, but we can supply the bare printed-circuit board with constructional data for £10.75.

We recommend that the board be cased not because of hazard to the user, but to protect the board from accidental short-circuit or mechanical damage.

K Reeman,
Ground Control,
Hullbridge,
Essex.

MISADVENTURE

There are a few minor errors in my Adventure program published in April. In lines 2904 and 3110 the number 10 should be the variable IO, the index of the object entry. Second, I have now amended lines 2420 and 2430 which should be as follows:

```
2420 IF X$<>"INIT"
     THEN GOSUB 6700
2430 IF X$<>"INIT"
     THEN GOTO 1000
2440 GOTO 70
```

This is necessary because the ZX-81 does not Save the Gosub stack. With this amendment a Saved game will automatically recommence after Loading.

Graham Thomson,
Northwich,
Cheshire.

STRING LENGTH

Graham Thomson's Adventure, in April, is an example of the intellectual satisfactions the ZX-81 can offer. His method of storing data in a single long string is a fascinating technique.

However, after spending much time in keying in Thomson's program and debugging my keying errors, I came to the conclusion that it, rather painfully, reinvents the wheel. In indexing a single long string one is almost writing a fresh ROM when the Sinclair ROM with its multi-dimensioning of strings already supplies a ready-made and clear index to vast numbers of strings.

My own attempt to write a *Dr Who* adventure, anticipating a visit from my grandson, employs a four-dimensional string, i.e., P$ (X,Y,X,20), the initialisation being

```
10 DIM P$(2,3,5,20)
```

Inkey$ is used to change the values of X, Y and Z. Thus a Go North instruction, press key N, is programmed to add 1 to Z; depressing key S subtracts 1. East or westwards moves are achieved by moving across the third dimension, by changing the value of Y.

Journeying into outer space or a new time zone is achieved after discovering *Tardis*, by using the U key to alter the value of X when a whole new hierarchy of places are opened up to north, south, east or west movements.

Object discovery is very simple. Arrival at a place for the first time causes the program to Gosub when the object and its score are digested, the object being put into an O$ string at a predetermined place:

```
LET O$(23 TO 28)="GOLD:"
```

Objects held are printed to the screen constantly, simply by calling a print of O$, without dimension. No loader was necessary. Indeed I found it simple to write the program straight from the keyboard with only a hazy plan of the outcome. As long as the main program is located at a high line number such as 2000, and plenty of space is left between lines in this main part to allow for plenty of conditional Gosubs such as

```
IF X=2 AND Y=3 AND Z=4 THEN
GOSUB (attack by Daleks)
```

the program can be elaborated ad lib.

G J Langford,
Ickenham, Middlesex.

PURE ARTISTRY

The Genie program Top Drawer, in *Your Computer* April, has one slight bug. No matter which key is pressed, the values of XX and YY will be unaffected, as the program always returns to line 20, before lighting the pixel. Therefore the values of XX and YY are reset to their respective initial values. To cure this rewrite lines 20 and 150 and insert a line 25 as follows:

```
20 XX = 62: YY = 24
25 SET (XX,YY)
150 GOTO 25
```

Here is a Genie drawing program, which requires less than 1K of memory and allows you to control the movement of a line by using the four arrow keys. Each key moves the spot in the direction of the arrow marked on the key. In addition, diagonals may be drawn by pressing two keys together, so if up arrow and left arrow are both pressed, then the line drawn will be to the upper left-hand corner.

As Peek is used instead of Inkey$, movement continues as long as keys are held down, rather than one place moved per press.

John Marshall,
Acomb,
York.

Pure artistry program

```
10  CLS
20  X=62: Y= 24
30  SET(X,Y)
40  Z=PEEK(14400)
45  IF Z=0 GOTO 40
50  IF Z<8 OR Z>80 THEN 40
60  IF Z = 8 THEN 65 ELSE 70
65  Y=Y-1 : GOTO 150
70  IF Z = 16 THEN 75 ELSE 80
75  Y = Y + 1: GOTO 150
80  IF Z = 32 THEN 85 ELSE 90
85  X = X - 1 : GOTO150
90  IF Z = 40 THEN 95 ELSE 100
95  X =X-1: Y = Y-1:GOTO 150
100 IF Z = 48 THEN 105 ELSE 110
105 X =X-1 : Y= Y + 1: GOTO 150
110 IF Z = 64 THEN 115 ELSE 120
115 X = X + 1: GOTO 150
120 IF Z = 72 THEN 125 ELSE 130
125 X = X + 1: Y = Y - 1: GOTO 150
130 IF Z = 80 THEN 135 ELSE 140
135 X = X + 1: Y = Y + 1: GOTO 150
140 GOTO 40
150 IF X<0 THEN X = X + 1
ELSE IF X> 127 X = X - 1
160 IF X<0 THEN Y = Y + 1
ELSE IF Y> 47 Y = Y -1
170 GOTO 30
```

TIGHT WRITING

Silent Running in the March issue is a good piece of very tight writing to fit into 1K. However it is easily run in the expanded machine without removing the RAM pack by simply lowering RAMtop. I Poked 16388,0 and 16389,73. This leaves over 2K usable so that the machine code runs properly and there is still plenty left to add a time delay and automatic rerun at the end. I have also added a high-score and some instructions.

Les Simpson,
Elm Park,
Essex.



Sharp colour prints from 3.5K pocket-computer system

THE PC-1500 pocket computer launched by Sharp has 16K ROM and 3.5K RAM, a seven-by-156 programmable dot-matrix liquid-crystal display and a tone generator. The RAM can be extended by an optional 4K CE-151 module to 7.5K. A C-MOS eight-bit CPU allows fast data processing.

Other features include a standard QWERTY typewriter keyboard and an ASCII character set with upper and lower case. A memory safeguard prevents accidental erasure of programs by ensuring that programs are retained even when the power is switched off. Its extended Basic provides two-dimensional arrays, variable strings, program chaining and graphics commands. Power is supplied by either four dry batteries or from the mains via a Sharp adaptor.

A CE-150 four-colour graphics printer and cassette interface is also available as an option. Virtually any drawing can be printed in red, black, green and blue, from pie charts to column graphs. The printer is capable of automatic program, data and calculation printing. Both the character size and the lines can be varied with the lines ranging from four to 36 digits in length. The cassette interface enables the PC-1500 to be connected to two cassette recorders, which allows information to be stored and retrieved on tape. Sharp is currently working on further options for the PC-1500, including an RS-232C interface and a software board to act as input keys in graphs or pictures previously drawn on a template.

A cassette of 15 applications programs is available, together with an applications guide, for £15. The programs include multiple regression analysis, simultaneous equations, numerical integration and conversion between decimal and base-P systems. The cassette also includes two games programs, Slot Machine and the nautical game Destroyer v. Submarine.

The PC-1500 pocket computer costs £179.95 including VAT; the CE-150 graphic printer/cassette interface costs £149.95 including VAT; and the 4K RAM CE-151 module costs £49.95 including VAT. All are available from Sharp Electronics (U.K.) Ltd, Sharp House, Thorp Road, Manchester M10 9BE. Telephone 061-205 2333.

Text editing

ZTEXT and LText are word-processing packages for the ZX-81 which include a text editor and a formatter/printer. The text editor allows you to type text in and edit it while the formatter/printer puts the text on the screen or ZX printer, and justifies and formats it according to commands embedded in the text.

ZText just uses upper-case letters, but LText caters for both upper- and lower-case characters. Both programs, together with a detailed manual, are available for £7.50 the pair, including VAT and post and packing, from Oasis Software, Lower North Street, Cheddar, Somerset BS27 3HH. Telephone 0934 743409.

Vulcan alert

VIC-20 manufacturer Commodore has linked up with Hendon-based electronics distributor Vulcan in a bid to make the Vic-20 available in a wide range of department stores and independent outlets. Commodore's Vic-20 is already sold in all Rumbelows, Laskys, Currys and Debenhams stores and will also be on offer in Dixons shops and 80 branches of Boots. Vulcan will be responsible for supplying the Vic-20 to all other retailers not covered by Commodore's present distribution network.

"Vulcan's role on behalf of Commodore will be to give new outlets a chance to experiment with the Vic-20 and learn how to sell this type of product", says Vulcan's managing director Robert Stein.

Winners of the national software competition for schools were presented with their prizes at Barclays Bank's head office in London by general manager Humphrey Norrington — third from the left. The senior competition was won by Roy Coote, Alan Tomkins, Dean Dennison and Michael Costin from Robert Clack Comprehensive School, Dagenham, Essex, with a program designed to assist an interior-design company. Winner of the junior competition was Truro schoolboy Paul Clark, 15 — second from the left — with a computer system for use in nurseries and garden centres. The winners of each competition were awarded £400 and a Kent Software Trophy to be held for one year. The winners' schools were presented with £1,000 worth of computing equipment. The competition is run by the University of Kent and is designed to foster an awareness among schools of the industrial and commercial uses of computer systems.



Viewdata on your micro

TELESOFT Tantel, a viewdata adaptor with RS-232 computer interface, has been launched by Tandata Marketing in association with Prestel. Software necessary for up- and down-loading the Prestel Telesoftware database has been commissioned by Prestel for the Apple, ZX-81, TRS-80 and Pet.

The software will be provided free to all buyers of the Telesoft Tantel adaptor except for Pet owners. The Telesoft Tantel costs £190 plus VAT from Tandata Marketing Ltd, Clyde House, Reform Road, Maidenhead, Berkshire SL6 8BU. Telephone: 0628 74661.

Lander EPROM

THE LM-124 EPROM programmer from Lander Microsystems is designed for use with the TRS-80 Model 1 Level II 16K Microcomputer. Housed in a plastic case, it is supplied complete with an integral power supply and a 20-page users' manual. No personality modules are required and all EPROMs can be fully programmed in one pass.

The LM-124 software includes a 256-byte page display, single inter-page keystroke and full cursor control. The system is compatible with EDTASM, the TRS-80 editor/assembler.

Although designed for the TRS-80, the LM-124 hardware can be used with other microcomputers, provided they have suitable software and the necessary control signals are accessible. Adaptors and software are currently being developed to allow the LM-124 to be used with the TRS-80 Model 3 and Genie 1.

As an introductory offer, the LM-124 is available for £57.50 until June 12 when the price goes up by £10 to £67.50. More details from Lander Microsystems, 32 Clockhouse Lane, Collier Row, Romford, Essex RM5 3QJ. Telephone: Romford 26325.

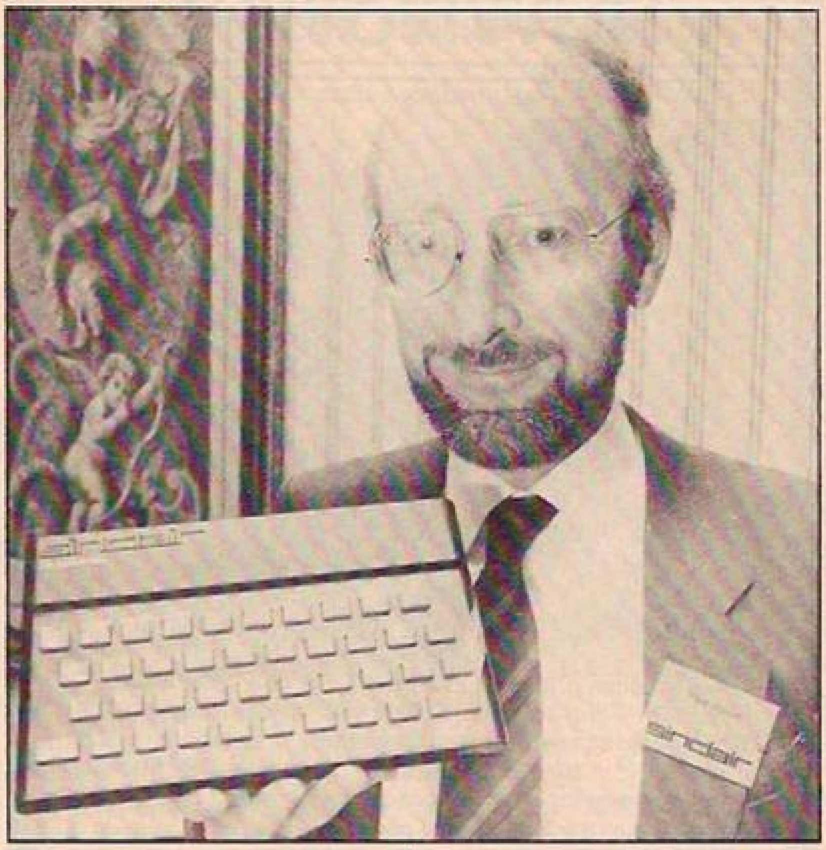
Restaurant in the sky

THE TAKE-OVER of British Airways is the objective of Airline, one of two business games for the 16K ZX-81 developed by Cases Computer Simulations. To take-over British Airways you must build up your capital by running your own airline at a profit.

Autochef is similar to Airline, but the objective of this game is to build up your company so that you can take-over Trust House Forte in the shortest possible time.

Airline and Autochef cost £4.75 each and are available from Cases Computer Simulations, 14 Langton Way, London SE3 7TL.

Sinclair softens up the cassette market



HOT ON THE heels of the launch of Sinclair's new ZX Spectrum — see Tim Hartnell's review on page 20 — Clive Sinclair has announced a new range of software for its predecessor the ZX-81. The 26 new cassettes will be available from Sinclair Research by mail order from May.

Nineteen of the new cassettes have been developed for Sinclair by ICL, the Government-backed computer firm. The remaining seven cassettes were developed by specialist software house Psion.

The Fun to Learn series consists of eight cassettes covering English literature I and II, geography, history, mathematics, inventions, spelling and music. Each cassette costs £6.95 including VAT. An additional eight cassettes, costing £4.95 plus VAT each, make up the latest set of Sinclair Research ZX-81 Super Programs series of games, quiz and conversion programs.

Other cassettes include Biorhythms, a six-level chess program and Space Raiders and Bombers. Flight Simulation puts you in the cockpit of an aircraft and judges your response to the controls and the outside world.

All the cassettes need the 16K RAM pack except for five of the Super Programs series which only need 1K. These cassettes are available from Sinclair Research Ltd, 6 King's Parade, Cambridge CB2 1SN. Sinclair has lowered the price of its 16K RAM pack from £49.95 to £29.95 including VAT. Sinclair says the reduction was caused by a major fall in chip costs. But rising production costs have caused Sinclair to up the price of its printer from £49.95 to £59.95 plus VAT.



Record 38,000 queue to visit Fair

OUR 1982 COMPUTER FAIR, held at London's Earls Court exhibition centre on April 23-25, attracted more than 38,000 people over the three days. This was the largest attendance ever at any personal computer fair in Britain. The Sinclair stand was rushed off its feet after launching the new Sinclair ZX Spectrum on the first day of the Fair.

The ZX Village was also very busy with microcomputing enthusiasts keen to discover the latest developments in ZX-80/81 hard- and software. Next year's exhibition will again be held at Earls Court on June 16-18.

Colour board wins £3,500

KEITH PURKISS, the 19-year-old who developed the first colour board for the Sinclair ZX-81, has won the £3,500 first prize in the *Daily Express*/Philishave "Get Up And Go" awards scheme.

The £17,000 award scheme was launched in January to encourage 16- to 21-year-olds to come forward with their own ideas for a workable business or project.

Keith Purkiss set up his own business — Haven Hardware — in July last year to design and market a range of computer hardware. The company's products include a programmable character generator, rotating key module, I/O port, memory expansion unit and a full-size keyboard for the ZX-81. Purkiss is currently working on nine more boards, including an inverse video for the ZX-81.

Thumper bites the dust

THE BRITISH HEAT of the Euromouse Maze Contest, held at the Computer Fair, was an absorbing battle. The pre-match favourite Thumper was beaten into fifth place by Alan Dibley's T3, Yet another Theseus, which found its way to the centre of the maze in a best time of one minute and 13 seconds.

David Woodfield's Thumper, which was credited with unofficial practice times of one minute dead and one minute and 13 seconds, mistook a piece of white tape for a wall and failed to reached the centre of the maze. First prize consisted of a trip to Haifa, Israel, in September, to represent Britain in the Euromouse Maze final. Second prize was a Sinclair ZX Spectrum won by Alan Dibley's Son of Theseus in a time of three minutes and 21 seconds. Phil Yeardley of Sheffield halted Alan Dibley's run of success by taking third place with Brainy Bricks in a time of four minutes and 53 seconds. He was awarded the latest Armdroid Robot.

Tony Porter's Maisymouse finished fourth, Alan Dibley's original Theseus came sixth while David Buckley's Marvin ended up in seventh place. All the contestants received one year's free subscription to either *Practical Computing* or *Your Computer*.

Alan Dibley watches anxiously as T3 storms to victory.



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Now, you can give your ZX81 more memory than a 48K Spectrum — for less than £50! If you already have a 16K RAM pack, of any make and regardless of condition, you can trade it in for **£12.50** against a Downsway 64K Memory, bringing the price down to only £47.45 (plus £2 p&p), compared to the Spectrum's price of £175!

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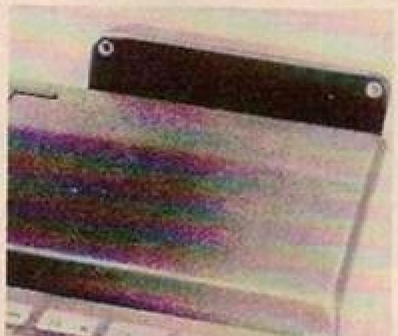
The 64K Memory gives 56K of available memory, and simply plugs into the ZX81 without needing an additional power supply, or adding any extra load to the internal 5V regulator.

Should you only need 16K of memory for your ZX81, the Downsway 16K RAM Pack offers the same benefits of high standards and low price at ony £24.95 plus p&p.

The slim, "low-profile" styling of both memories compliments the ZX81, and a special foam cushion provides added mechanical stability.

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ZX81 16K

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Computer Club is here to encourage you to start your own local computer club or, if one already exists, to join it and become involved. Each month we will devote the page to new ideas from local clubs. We would like to hear of anything which has made a club a success, or of any projects or programs you are developing.

BBC hits East London





The books' days are numbered at Harrow Green library. On the second and fourth Tuesday evenings of every month, local micro enthusiasts gather there to develop their expertise. Brendon Gore went along to check out the East London Amateur Computer Club.

JANET CORNISH, one of the 12 who founded the club in 1978, introduced the BBC Microcomputers, and pointed out that the Model B had eight display modes, while the Model A only allowed modes 4,5,6 and 7.

The three Model Bs at her disposal proved that Acorn is finally clearing some of its backlog. Janet Cornish used different colour modes to create a variety of shapes from a simple map to multicoloured flashing triangles. In mode 5, for example, colour 1 selected a red foreground and colour 129 selected a red background. Similarly, colour 2 resulted in a yellow foreground and colour 130 created a yellow background. The CLS command cleared the screen to the background colour.

The Draw command, which can be used in modes 0,1,2 and 4, enables you to draw a line from the pre-set cursor position to the specified x and y values. Thus Move 300,200 and Draw 1000,1000 sets the cursor position and draws a line to the required spot on the screen. The screen is addressed as x, points 0-1279 and y, points 0-1023, she noted.

Character redefinition

VDU can be used to redefine the character set, change the colours in different modes and to set up your own text windows. VDU 4 separates the text and graphics cursors, enabling you to operate both inside and outside the text window, while VDU 5 reverses the process.

The talk was warmly received by the 40 members present. Club chairman Fred Linger announced forthcoming events. Dick Marsh will talk about screen editing on June 8, while Mr Parran will discuss the effects of computers in education on July 13. Peter Wright is expected to throw some light on the subject of EPROM burning on August 10.

A previous talk on the subject of Forth, given by Mike Curtis of the Willesden College of Technology, spawned a Forth interest group inside the club. Other club activities include a library of books and programs, and a monthly newsletter edited by Ed Lepley and Jim Turner. The newsletter carries information about the club and its members, tips on hardware and software problems and lists future events. A monthly puzzle, for club members only, is also a popular item.

Mode	Graphics	Colours	Text
0	640 by 256	2	80 by 32
1	320 by 256	4	40 by 32
2	160 by 256	16	20 by 32
3	—	2	80 by 25
4	320 by 256	2	40 by 32
5	160 by 256	4	20 by 32
6	—	2	40 by 25
7	Teletext	2	40 by 25

BBC graphics mode.

The March puzzle consisted of writing a Basic program to input any two numbers and print them in ascending order of value. To make it a little more difficult entrants were not allowed to use Calls to machine code, USR, Peek, Poke, Data statements or calls to other monitor routines. In addition, entrants were not allowed to use Basic comparative commands such as If — Then or On — Goto or Gosub.

The simplest solution to the puzzle, published in the club's April newsletter, consisted of the following program:

```
10 INPUT "Enter 2 numbers";A,B
20 PRINT (A+B-ABS(A-B))/2
30 PRINT (A+B+ABS(A-B))/2
40 GOTO 10
```

Club membership costs £4 a year for adults and £2 a year for students and old-age pensioners. More information is available from the club's publicity officer Jim Turner, 63 Millais Road, London E11 4HB. ■

Local society news

Laserbug

LASERBUG IS THE London and South East Region BBC Microcomputer Users' Group. A newsletter edited by Trevor Sharples aims to share ideas and discoveries about the BBC Microcomputer. Laserbug also hopes to encourage the setting up of local groups under its banner. A year's subscription to Laserbug costs £12. For further details write to Laserbug, 4 Station Bridge, Woodgrange Road, Forest Gate, London E7 0NF.

Vic-20 User Group

MATTHEW STIBBE of The Lawn, Lower Woodfield Road, Torquay, South Devon, hopes to start a Vic-20 user group and software library. Anyone wishing to borrow or contribute programs for the Vic-20 should contact Matthew Stibbe at the above address.

Norwich BBC User Group

MEETINGS OF THE Norwich and District BBC Microcomputer User Group are usually held twice a month at the Norwich City College. They consist of either a computer workshop or a talk about some specific area of microcomputing. For more details contact Paul Beverley at Room 12a, Norwich City College, Ipswich Road, Norwich, Norfolk, NR2 2LJ.

North Wiltshire Club

NORTH WILTSHIRE Computer Club meets at Holt village hall on the second and fourth Wednesdays of each month. Everyone is welcome, from the absolute beginner to the expert, on payment of 50p entrance fee. More information from Matthew Jones, Pinhills, Bowood, Calne, Wiltshire, SN11 0LY.

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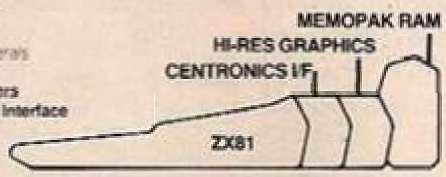
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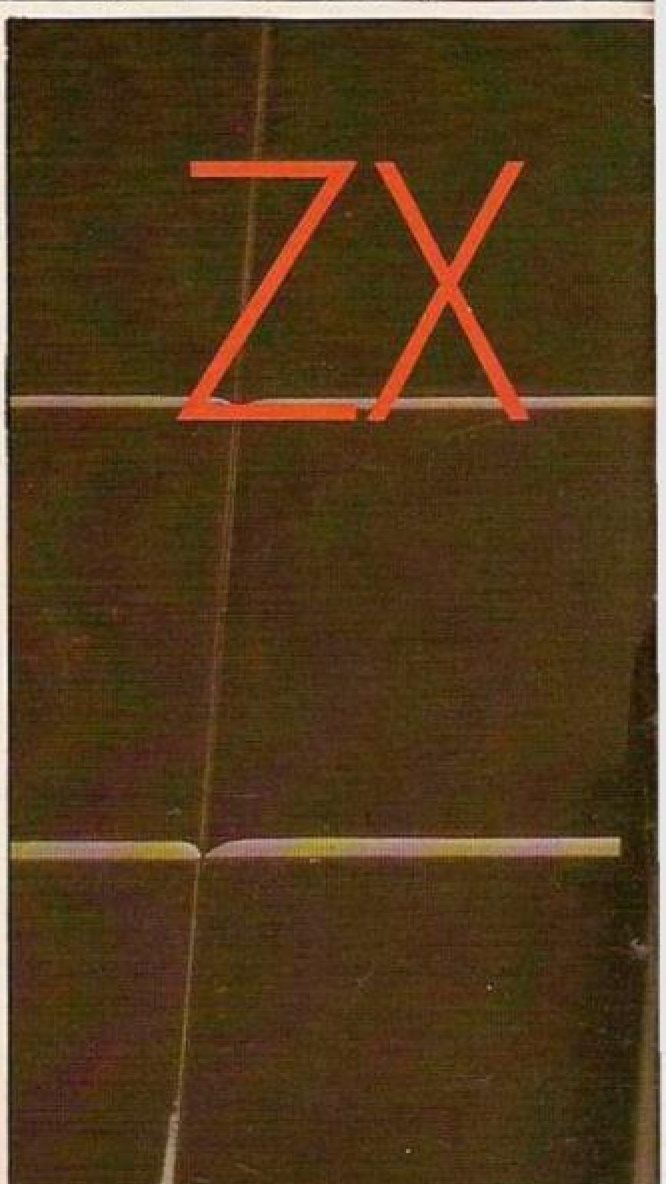
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REVIEW

SINCLAIR ZX



The new Sinclair has arrived at last — a book-sized micro-computer with colour and sound and an extended version of ZX Basic. It came through its test well ahead of the competition but, as Tim Hartnell found, even Sinclair Research cannot work miracles.

LAUNCHING THE SPECTRUM, Clive Sinclair confessed that there had been considerable disagreement within his organisation over the name of the new computer. "At one point", he said, "we thought of calling it 'Not the BBC Micro'". In March last year, Sinclair unleashed an angry tirade against the BBC for giving Acorn the right to make the computer for the TV series, saying that he had told the BBC he could produce a computer — within their specifications — for just over £100. The ZX Spectrum is the fulfilment of that promise.

The Spectrum has eight colours, a built-in sound generator and loudspeaker, and the closest Sinclair Research has come to a "real" keyboard. Its specifications exceed those of the Model A BBC machine, and come close to the Model B in many areas. At just £125 for the 16K model, the Spectrum is the same price as a ZX-81 with 16K pack when first launched. With 48K the Spectrum costs £175.

The Spectrum uses a "superset" of ZX-81 Basic, and any ZX-81 program can be typed in with the minimum of changes; ZX-81 tapes cannot be loaded into the Spectrum. The new computer loads and saves much more quickly than does the ZX-81, at 1,500 baud as against around 250, and the upward compatibility of listings should mean a lot to organisations like Muse which are building up a library of educational ZX software. Publishers of ZX literature or ZX software breathed a sigh of relief on hearing that ZX-81 listings could be entered directly.

The Spectrum works in upper- and lower-case letters, and does so like a typewriter: capital letters appear only when you use the shift key. The computer does not differentiate between upper and lower case when naming variables — so A$ is the same as a$ — and will ignore spaces in variable names.

The range of characters is standard, and symbols such as ! and # are available on a ZX machine for the first time. There is a range of three different curly brackets and a cute little © copyright sign.

The © sign, and the words "Sinclair Research Ltd" appear on the screen in black letters on a white ground when you first turn it on. Pressing New LList or Copy produces some remarkable flashing-border displays, and in Save and Load you are treated to a lollypop-striped screen in reds, blues and yellows.

The error codes are fascinating, and in English rather than the odd little numbers and letters of the ZX-80 and ZX-81. If all goes well in a Load, a Save, a program execution or whatever, the computer prints "OK" at the bottom of the screen. If you manage to make it swallow an incorrect line or parameter — which is difficult to do, because all lines are checked for syntax before being accepted into the main body of the program — the computer prints the delightful line

Nonsense in BASIC.

Whoever wrote the ROM had a sense of humour.

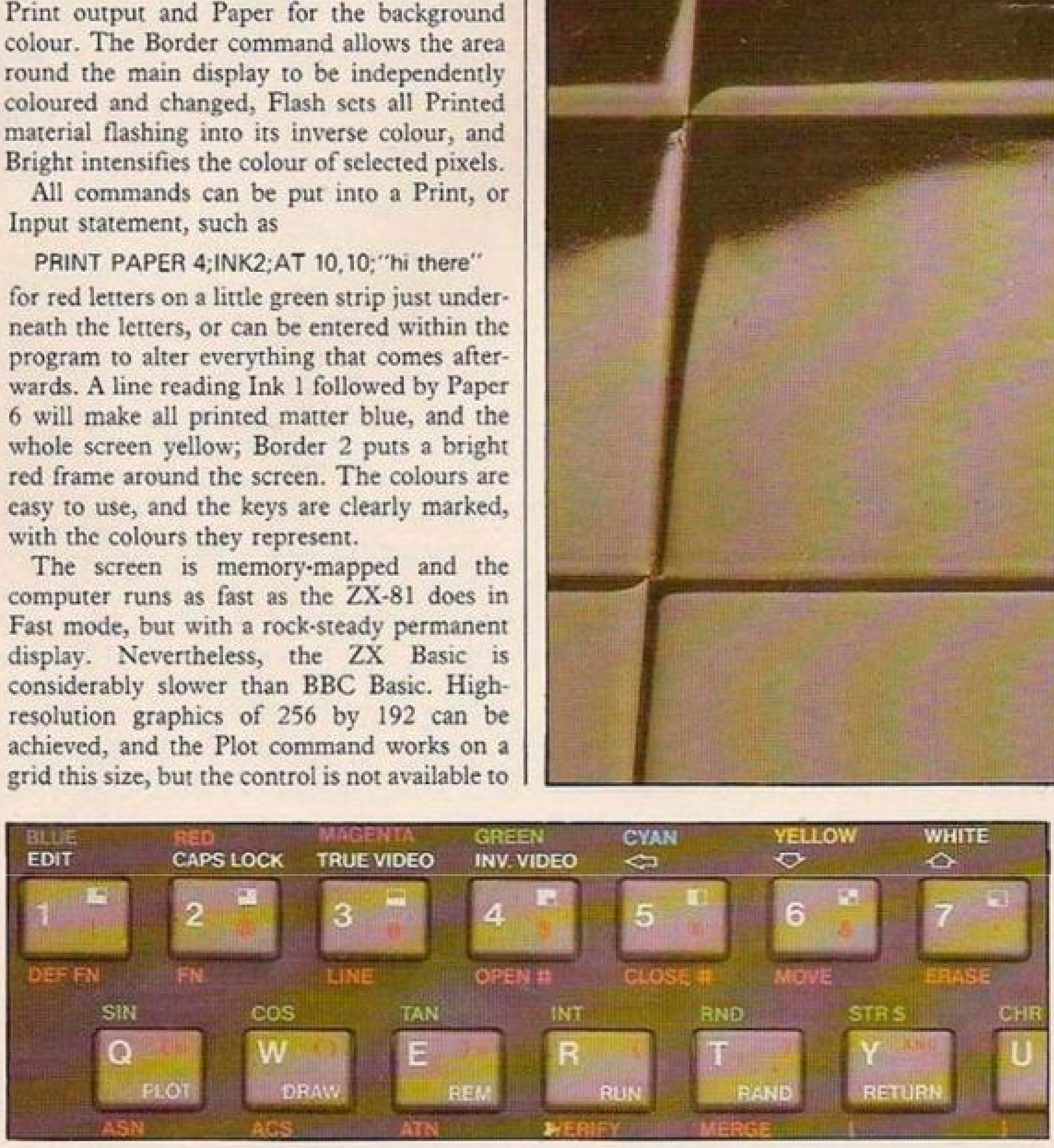
There is much in Spectrum Basic to tempt you to enhance your programs. It includes Beep, a single-channel "music" command with both duration and pitch under user control, Ink to determine the colour of the Print output and Paper for the background colour. The Border command allows the area round the main display to be independently coloured and changed, Flash sets all Printed material flashing into its inverse colour, and Bright intensifies the colour of selected pixels.

All commands can be put into a Print, or Input statement, such as

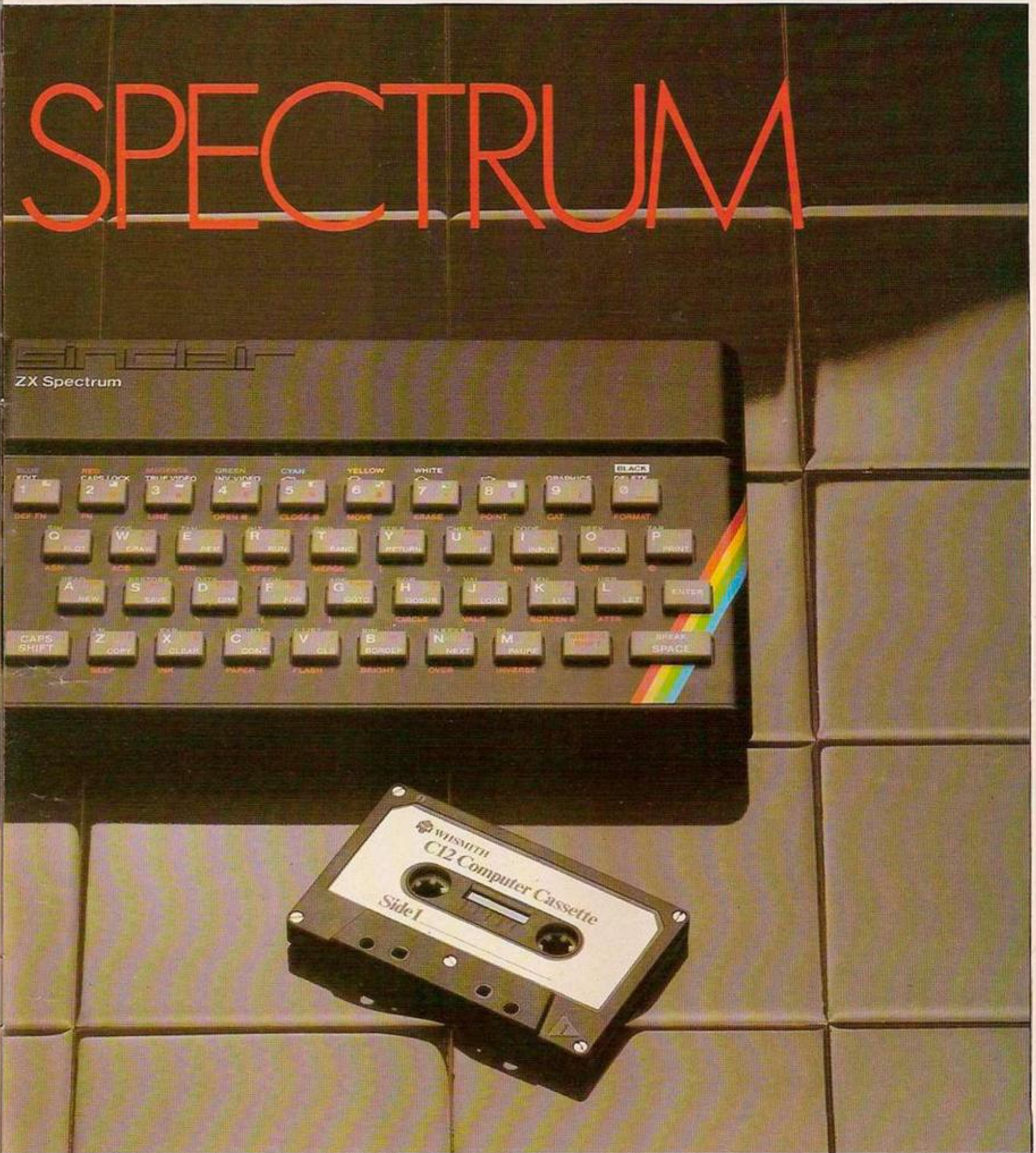
```
PRINT PAPER 4;INK2;AT 10,10;"hi there"
```

for red letters on a little green strip just underneath the letters, or can be entered within the program to alter everything that comes afterwards. A line reading Ink 1 followed by Paper 6 will make all printed matter blue, and the whole screen yellow; Border 2 puts a bright red frame around the screen. The colours are easy to use, and the keys are clearly marked, with the colours they represent.

The screen is memory-mapped and the computer runs as fast as the ZX-81 does in Fast mode, but with a rock-steady permanent display. Nevertheless, the ZX Basic is considerably slower than BBC Basic. High-resolution graphics of 256 by 192 can be achieved, and the Plot command works on a grid this size, but the control is not available to



SPECTRUM



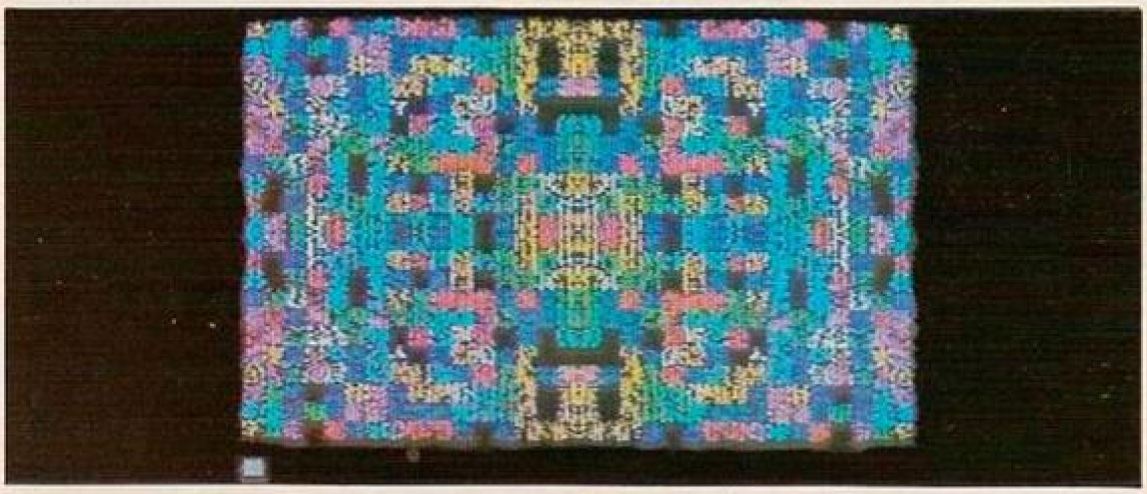
the same resolution. Colour works on a grid of 32 by 22, the same grid as for letters. Read, Data and Restore are available, as well as Def FN and FN, and enhance the capabilities of the computer considerably.

It is obvious that Sinclair has listened to those who have criticised some shortcomings of the ZX-80 and ZX-81. The Load and Save procedures on the earlier machines, in particular, left a great deal to be desired. The Spectrum Loads in blocks, sets the record level automatically and suppresses noise. Once you think you have a program successfully on tape — and before you New it from the computer — you can play it back into your computer using the Verify command, to make sure it is there safely. The very first program I attempted to save on the Spectrum Saved, Verified and Loaded successfully at first attempt.

The new Load and Save, along with the fact that the memory can be relied on not to drop out unexpectedly, make working with the ZX Spectrum a pleasure. The awful fear that your carefully keyed-in program is about to vanish into thin air has been banished. The 16K or 48K memory is permanently fixed inside the Spectrum. You cannot use the ZX-81's 16K pack, though the new computer does operate the ZX printer.

The ZX Spectrum is small and flat, rather wider than the ZX-81 but not as deep. The

(continued on next page)



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keys are rubbery, and appear to press on to a standard ZX keyboard. You can use them without looking at the keyboard, once you know your way around it, and a touch-typist will soon feel at home. The key action is positive — although you need to squeeze the keys rather than press them — and there is no need to keep checking the screen to see that each keystroke has been entered.

All keys have auto repeat, which is a boon for running out parts of lines or for moving the cursor along the long line you wish to edit. The Spectrum makes a clicking noise while auto repeat is working. If you start the auto repeat with a key which requires Shift such as Delete you can take one finger off the Shift and just leave it on the Delete key once the auto repeat is underway. The Edit facility is the simplest to use of any computer on the market, it is better than that on the BBC Micro, except that you cannot join together parts of separate program lines.

Symbols and keywords

The keys on production models are to be light-blue, with the alphanumeric symbols and keywords marked in white. Function symbols such as ?, At, Then and + are in red.

Sinclair invented the "one-touch key" system for the ZX-80, which ensured that the computer knew that the first key pressed after a line number, or after the word Then, would produce a keyword, such as Let, Print, Poke or Goto. This meant that programming was fast and positive. The ZX-81 demanded a sequence of key presses — such as Shift, then Function, then a key — to get the results you wanted. Sinclair is obviously wedded to the one-touch entry system, but it is really not suited to the Spectrum. The sequence of key presses required for Ink and Atn, for example, requires the same number of key presses as would be needed to type the word in directly.

There are now two Shift keys, a white one and a red one. The white one works like the standard shift key on a typewriter, turning lower-case letters into capitals and, in the Graphics mode, producing the graphic rather than the number from the keys 1 to 8. The red Shift key, on the bottom right-hand corner of the keyboard, is used for words such as At, Or, And, Then and Step, along with the full stop, the colon for multi-statement lines, and the $ sign. The = sign is also accessed by using this shift, then pressing L, but as these are next to each other, you will soon find yourself pressing both keys at once with your right hand to enter the = sign.

You must press both shift keys at once, followed by another key press, to enter words such as Int, Rnd, Chr$ and Codes. Other commands, such as Ink, Paper and Beep, require both shift keys to be pressed at once, then the red one to be held down while the relevant key is pressed.

Unfortunately, the command New is as easy to access as Print and Goto — no Shift keys or juggling needed. This is sure to result in programs being wiped accidentally, especially as New lies between Copy and Plot. By contrast, the harmless Stop command, on the same key, needs two key presses. Designing the New like this suggests that not enough thought has been given to human behaviour.

Other aspects of the keyboard show more care in their design. The Then and Goto are on the same key, as these are often accessed one after the other; the same goes for For and To. There is a single apostrophe — a wise lesson learned from Atom and BBC Basic — to move the Print statement down a line, so

```
PRINT ' ' "HI"
```

will skip two lines before printing the word "HI".

The List command takes some getting used to. Pressing List will give you a page of program, then the message

```
scroll?
```

will appear in the bottom left-hand corner. Pressing any key except "n" allows the listing scroll to continue, page by page. The current-line cursor, an inverse > symbol on the ZX-81, has been replaced by the same symbol displayed in normal mode. It is not particularly easy to see, and you can spend a lot of time running your eyes up and down the column after the line numbers to find it. Using List n to find a line you have requested is almost comically difficult.

The Beep command is simple to use, and the volume from the internal speaker is adequate. The sound output can be tapped from both the Mic and Ear sockets at the back, to drive an earpiece or to feed into an amplifier. The word Beep is followed by two parameters. The first is the duration of the tone in seconds — fractions of a second, such as .05 or 17/36, are also accepted — followed by a comma, followed by the frequency. Middle-C is a 0, so

```
Beep 1,0
```

will play middle-C for one second. Higher numbers produce higher notes, with negative numbers for notes below middle C. There is a range of around 130 semitones, and fractions of a tone are accepted.

The graphics are a development from those of the ZX-81. All the standard ZX symbols are there, made from quarters of a character square, with black and grey, along with their inverses. The new Draw command draws a remarkably fine line from the co-ordinates of the Plot command and can therefore be used as a substitute for Move. The Draw command can also be used to draw parts of circles by adding a third parameter, the angle to be turned through. The Circle command — naturally enough, it draws a circle — needs three parameters: the x and y co-ordinates of the centre, and the radius. The circles drawn appear very close to true circles, especially if a fairly large radius is used.

Lower-case letters

The lower-case letters, formed on an eight-by-eight character grid, are fairly good, although the descenders only go down one pixel.

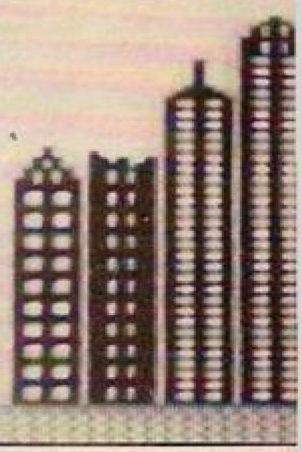
You can define up to 21 of your own characters, using a remarkable function called Bin — for binary — which allows character shapes to be Poked into position. The new character can be assigned to any key. Chr$8, is a back-space which does not erase the character, and you either overprint, using the command Over, or underline. Far more sophisticated than on the ZX-81, the Spectrum graphics will prove a boon for improving screen and printer output, although they will also be more difficult to master.

It is good that Sinclair has decided not to kill the ZX-81 as it is still the ideal first computer. Those who know how to program a ZX-81 will find they can gain reasonable facility with the Spectrum within a couple of hours. After countless hours staring at the black, greys and whites of the dumb ZX-81, the brilliant colours and the Beeps from the Spectrum will ensure that even your dullest programs at least look interesting.

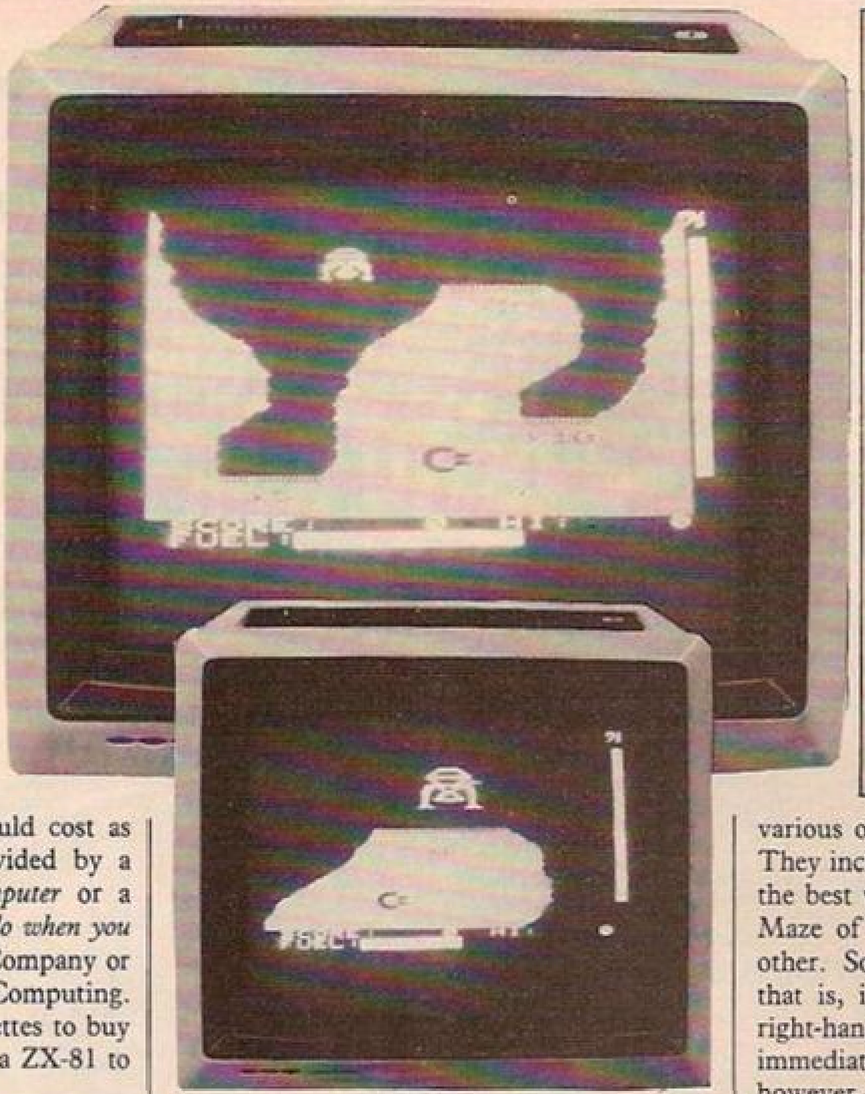
CONCLUSIONS

- With powerful colour and sound commands, the ZX Spectrum is a remarkable computer, exceeding the BBC Model A in specification.
- Its use of a Basic very similar to that of the ZX-81 provides a ready-made source for software, though ZX-81 tapes cannot be loaded into the Spectrum.
- Programs can be saved and loaded without the problems which plague the ZX-81. Built-in memory means that sudden program loss should no longer be a problem, but ill-considered keyboard design means that programs could still be lost by inadvertently keying New.
- The moving-key keyboard is an improvement on the touch-sensitive board.
- The one-touch entry system, retained from the ZX-81, is not suitable for the Spectrum and leads to complicated multi-shift operations when keying some functions. It should have been discarded.
- Despite minor faults, the Spectrum is way ahead of its competitors. There is certain to be a rush for orders. ■

VIC-20 SURVEY



Which breakout bat moves too slowly to catch the ball? Which version of space invaders is so tinny that it has become known as "the massacre of the saucepans"? Boris Allan answers these questions and many others as he and his dedicated band of testers sort cassette and cartridge programs for the Vic into the good, the bad, and the ugly.



A FEW PROGRAMS on cassette could cost as much as the 300 programs provided by a year's subscription to *Your Computer* or a book of listings such as *What to do when you hit return* by People's Computer Company or *Basic computer games* by Creative Computing. At about £6, it takes only 22 cassettes to buy another Vic, and 10 or 11 to buy a ZX-81 to extend your experience.

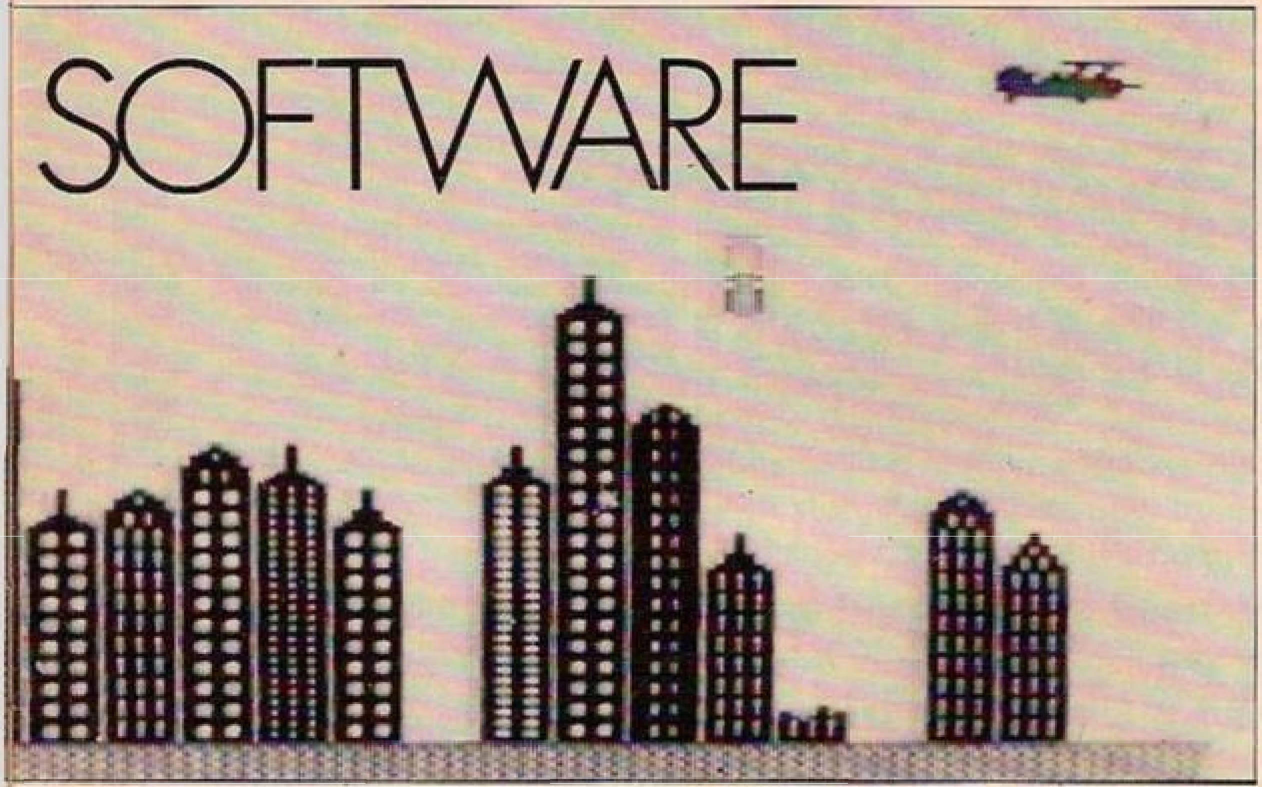
Assessing true value

The cost of most of these programs is even more surprising when one considers that some very good disc-based Adventure programs for larger microcomputers cost only £15 — and some of those programs have really excellent graphics. Given the quality of the majority of programs tested, and taking into account the cost of the cassette, and postage and packing, to sell them at more than £1.50 could reasonably be viewed as expensive.

Obstacle or Maze is probably the most popular games variant. These are games in which you have to find your way through a maze or a minefield where you must dodge various obstacles which are fixed or moving. They include Bug-Byte's Vicmen, in our view the best version, at one extreme and Abacus' Maze of Death, the least impressive, at the other. Some programs had wrap-around — that is, it was possible to disappear on the right-hand side of the screen only to appear immediately on the left. It was not possible, however, to disappear at the bottom to reappear at the top. This wrap-around often seemed uninentional, and is easily explained if you study the way the screen is organised on the Vic.

On the Vic, the screen is arranged in 23 lines of 22 characters, and each location on the screen is given a number. For four lines of four characters, the numbers might be:





32	33	34	35
36	37	38	39
40	41	42	43
44	45	46	47

So, moving along the top line from left to right, to go to the right of the top-right location, 35, is to move to position 36, which is on the second line down, on the left. To move upwards in a straight line one subtracts 4, 45, 41, 37, 33, and so one does not wrap-around at the bottom. This facility is used to greatest effect in Vicmen.

Variations on a theme

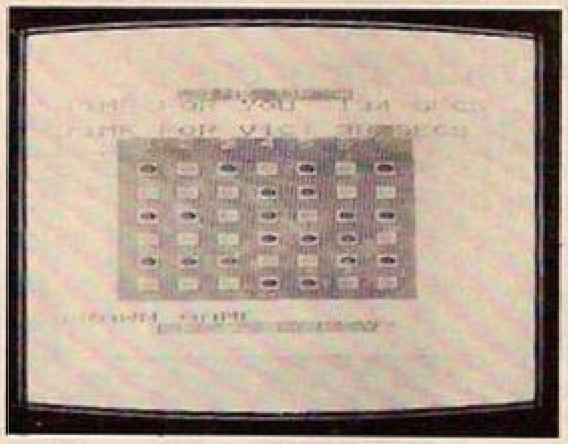
Breakout programs are variations on the "knock bricks out of a wall" theme, and none of the ones tested is an improvement on a game in Integer Basic for the Apple II — though that game uses paddles or joystick. Most of the programs in this category strive for originality in many ways, but why change from the best version? All these programs used keys, and in at least one case — Blastout 1 from Neme Software — the bat moved so slowly that it could not catch up with the ball.

The breakout style of program uses real-time control, as do some of the maze or obstacle programs: real-time control is where the user has to manoeuvre in a continuously varying situation. This category includes various types of road race, landing a spaceship safely by use of a visual display — not to be confused with an older type of program called Lem in which the only useful information is height, speed, and fuel. Perhaps the best of this category is the Commodore cartridge Road Race and the worst is probably Monaco GP from Abacus.

In the space invaders or war games category we have all the many variants of space invaders, and the various other shooting games — some played against the computer and some against an opponent. In our view, by far and away the worst program was Bridge Software's Vic Invaders — it was suggested by one of the test panel that it be renamed "The massacre of the saucepans" — while dK'tronics' Rox and the Commodore cartridge Avenger seemed to be the most popular.

One of the cassettes in the intelligent games section, Line Up 4 from Terminal Software, made the most favourable impression because it consistently won a test of intellectual skill — it is a simulation of the popular game where you have to connect four counters in a row. An intelligent game is one such as chess which requires thought and not dexterity. If a noughts and crosses program is supposed to be at all intelligent, a good trap is to play top right. It will then play in the middle, and so you choose bottom left: most programs will then move to either top left or bottom right, and so lose — both Noughts 1 and Noughts 2 from Neme do.

The logic and mathematics programs



include number guessing games, or games of logic such as Mastermind. None of the programs tested provided the player with any real challenge. They were the Neme Mastermind and Save Sum City, Abacus' Petals Around The Rose, Mastermind from Control Technology, and the PR Software Logic and Pickup Game.

Some of the programs are best considered as demonstrations of what you can do with your micro: for some we cannot think of any other reason for their existence. The Commodore cartridge Super Slot, for example, is an ostensibly tiresome slot-machine program but which has graphics effects that we had to admit were good. Many of the programs on the Commodore cassette Introduction to Basic Part 1, are demonstrations, and some like Hangman and Speedtype were enjoyed for themselves.

We shall now consider some of the most highly recommended programs. The first is Vicmen which was supplied by the Byte Shop, Manchester. Vicmen is produced by Bug-Byte and costs £7. It is a version of an arcade game called Puckman, and is a real-time maze program with excellent graphics. Vicmen is a skilful game which consists of trying to gobble spots before being caught by ghosts, though at times you can chase the ghosts to turn them into eyes. The reason it is so successful is that it is different, not too complex, and fun to play.

Simple addiction

Blitz might be classed as a space invaders or war game, because it consists of a bomber flying over a town again and again. At every pass, it reduces altitude, until it runs into a building. To stop it crashing you must flatten the buildings by dropping bombs, but only one bomb is allowed in the air at one time. It sounds simple, but it becomes almost as hypnotic as Vicmen. Blitz is produced by Commodore and costs £4.99 — a very good example of how you do not have to be complex to be addictive.

Line Up 4 is definitely an intelligent game. It is a simulation of a game of Connect 4 — if you are not wary, or not sufficiently good, it will win. An interesting extra are the timings of how long you took, and how long the Vic took. It beats you, and then boasts about how quick it is. A well-presented program with good, clear instructions from Terminal Software.

These are far and away the best games, but there are others which are reasonable — we felt, however, that a program had to be exceptional to command the prices being asked. These three programs were the only ones for which there was unanimous acclaim, and it is worth asking why they had this universal popularity.

They are successful because:

- They are very simple in conception, with no gratuitous complications.
- They are not like any of the other games.
- Because listings of these games are not easily available, their themes are not hackneyed.
- There are no bugs in the programs; they were not too simple to play nor were they too difficult.

One can also learn from the games we felt to be the least successful. Bridge Software's Vic Invaders, for example, at £6.50 is too easy, the invaders do not advance, there are no mystery ships, the base at the bottom zips along at rocket speed, and the invaders do not speed up when only a few remain.

Fiendishly clever

Petals Around The Rose is a number guessing game with a difference — it does not tell you the rules. Consequently the user can never be sure if the game is fiendishly clever because he can never know what he is supposed to be doing. At £6.95 from Abacus Programs, it might not seem worth the effort.

At the end of the review of the Games Package from Neme Software — £5.50 for five programs, or £9 for the set of 10 — was

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written "Keep Clear". This becomes understandable when you discover that the program Pontoon does not recognise pontoon. We were unable to tell the difference between Noughts 1 and Noughts 2, and the bat seemed incapable of catching up with the ball in the Neme version of Breakout. It can be seen that the programs were trivial and, what is worse, poorly de-bugged.

We would advise anybody buying programs either to see them demonstrated first, or to obtain a written undertaking that the program can be returned if unsatisfactory.

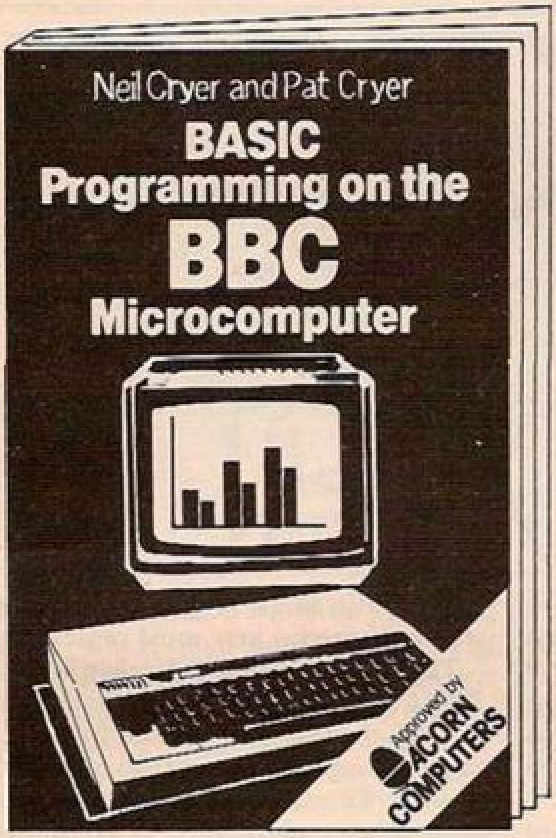
Company	Program	Category	Comments	Price
Neme Software	Games Package:		Trivial and poorly de-bugged	Five for £5.50 10 for £9
	Pontoon	D		
	Mastermind	L/M		
	Shell Game	D		
	Noughts 1	IG		
	Noughts 2	IG		
	Clocks	D		
	Black Holes	O/M		
	Save Sum City	L/M		
	Blastout 1	B		
	Blastout 2	B		
	Sonic Patterns	D		
	High resolution /character package	D	Fair	£7.50
	Songmaster music package	D	Fair	£6.50
Commodore	Blitz	I/W	Brilliant	£4.99
	Basic Intro: 1	D	Fair	£14.95
	Cartridges			
	Super Slot	D	Tiresome	£19.95 each, plus VAT.
	Super Lander	RTC	Fair	
	Avenger	I/W	Good	
	Road Race	RTC	Good	
Bridge Software	Vic Invaders	I/W	Avoid	£6.90
Terminal Software	Panic Driver	RTC	Fair	
	Line up 4	IG	Brilliant	
Abacus Programs	Splotter	O/M	Tiresome	£6.95 each, or £12.95 for two
	Space Docker	O/M	Fair	
	Guzzler	O/M	Good	
	Defender	I/W	Fair	
	Petals Around The Rose	L/M	Avoid	
	Monaco GP	RTC	Bad	
	Lunar Lander	RTC	Fair	
	Maze of Death	O/M	Bad	
	Minefield	O/M	Fair	
Bug-Byte	Vicmen	O/M	Brilliant	£7
	Another Vic in the wall	B	Good	£7
dK'tronics	Rox	I/W	Good	
	Deflex	I/W	Tiresome	
	Tanx	I/W	Unreliable	
	Space Zap	I/W	Fair	
Control Technology	Vicsoft 7 package			
	Moroids	RTC	Moronic	£5.95 for seven
	Death Race 2000	RTC	Bad	
	Mastermind	L/M	Bad	
	Breakout	B	Avoid	
	Warlords	B	Avoid	
	Squash	RTC	Tiresome	
	Sounds	D	Fair	
PR Software	War	I/W	Good	£7.50 for six
	Smashout	B	Fair	
	Blackjack	D	Good	
	Logic	L/M	Fair	
	Pickup game	L/M	Poor	
	Alarm Clock	D	Fair	

Notes: In the category column the following abbreviations have been used: O/M, obstacle or maze game; B, break-out type game; RTC, game with real-time control; I/W, space invaders-type or war game; IG, intelligent games; L/M, logic or mathematical programs; D, demonstration programs. ■

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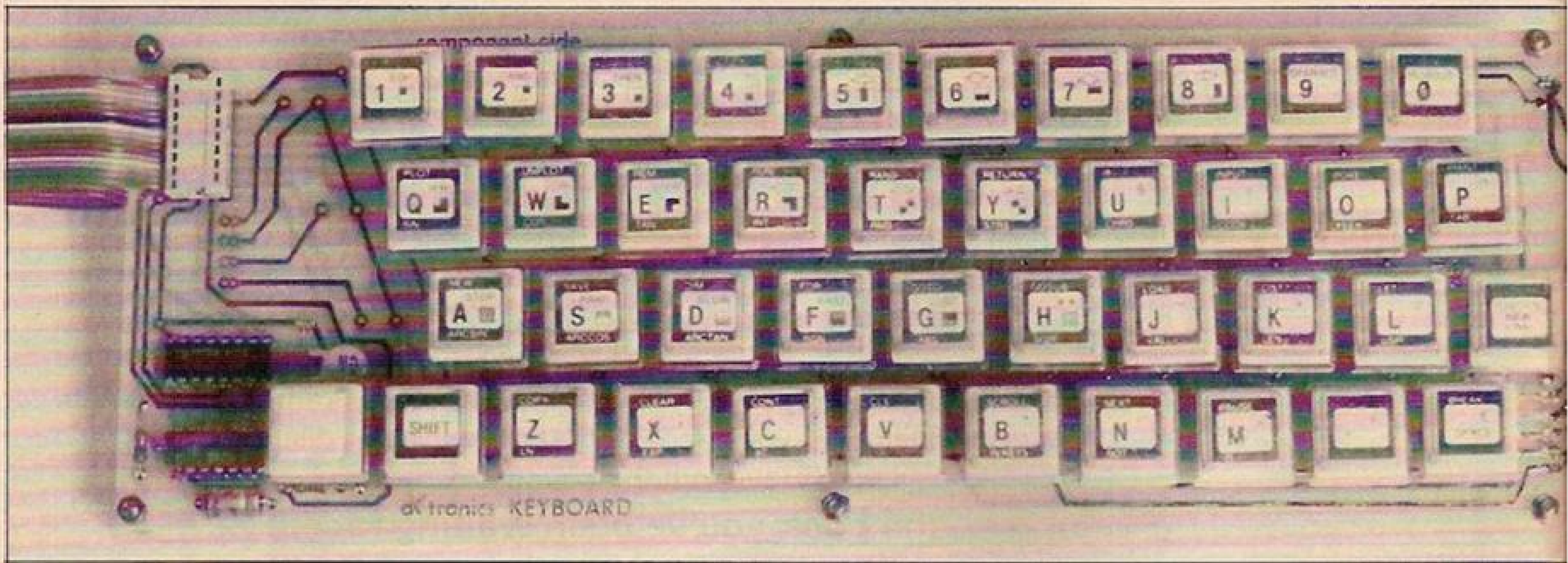
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SURVEY KEYBOARDS FOR ZX-81

Do you find the only drawback to your Sinclair is that slow, awkward keyboard? Stephen Adams examines the solutions offered by a number of manufacturers and finds that a new keyboard could cost you as little as £20 or as much as another ZX-81.

THE MOST COMMON complaint about the ZX-81, or for that matter its predecessor the ZX-80, is its keyboard. The keyboard on both machines is made from three layers of plastic. The top layer contains the keyboard symbols on the outside and a metal track on the inside. This metal track forms one side of a switch.

The bottom layer is the same, but with a metal track on the inside facing the top layer. Between these two metal tracks is a plastic membrane which keeps them separate. Beneath each key position the membrane has circular holes though which the top and bottom metal tracks connect when the top layer is pressed.

The whole keyboard is only 1/8th in. thick so it can be difficult, without watching the screen, to tell if you have pushed hard enough to make contact. As a result users tend to push far harder than necessary and often for far too long. The increase in speed that results from replacing the ZX-81 keyboard with push-button keys can mean a 50 percent saving on the time taken to input information.

The keys on the Sinclair keyboard are arranged in the form of a matrix, with eight input wires, or address lines, and five output wires, or keyboard data (KBD) lines. Each switch is connected to one address line and one KBD line and when pressed makes contact between them. By checking the KBD lines affected when an address line is altered, the ZX-81 can tell which key has been pressed.

Easy to fit

For instance, the shift key will have been pressed if the address line A8 was affecting output wire KBDO. Therefore the only wires that need to be connected to the keyboard are the eight address wires and the five KBD lines.

These appear on two sockets mounted inside the ZX-81, so all that is required is to remove the plastic tails which connect up the ZX-81 keyboard, and insert the leads from the new one. There is a hole between the 0 and the 9 key through which the old keyboard tails pass.

As this hole cannot normally be seen, you must push down on the top of the keyboard in order to push through the flat ribbon cable.

The best instructions are those supplied with the Redditch keyboard. They contain six drawings showing how to open the ZX-81, remove the keyboard tails and attach the new ones from the keyboard. The Fuller, Redditch and Computer Keyboards are the only ones which do not require soldering of the keyboard leads to the ZX-81 even though, as d'Ktronics point out, little damage can be done by making a wrong connection.

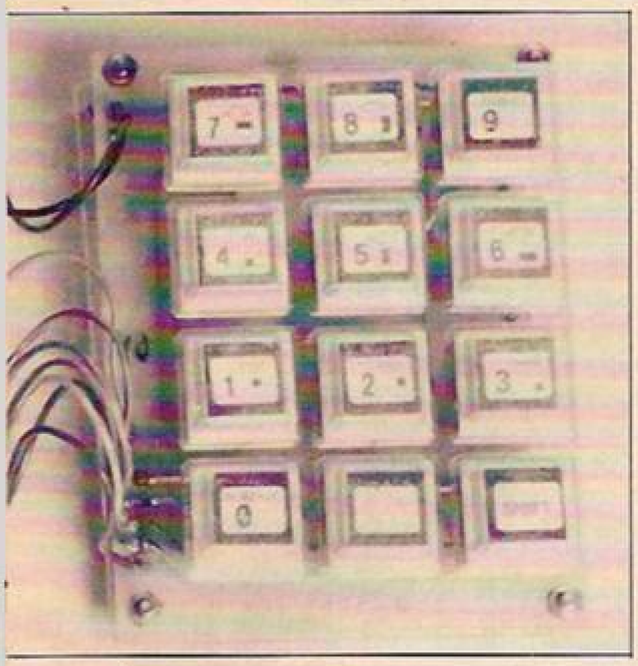
The other keyboards all require a connection to the +5V and 0V supplies on the ZX-81. A wrong connection here could cause damage.

There are 40 standard Sinclair keys on the ZX-81 and although they can have more than one use, they are all controlled from software, so only a single-contact push-to-make switch is required for each key. All of the keys on the keyboards supplied were designed for this purpose and you should find no problems in using them. They have, however, different key-tops and layouts.

Angle of attack

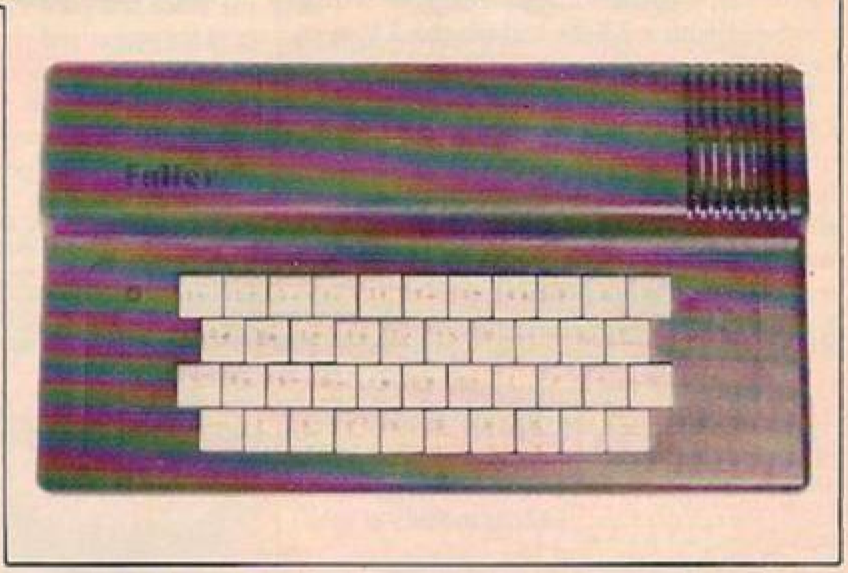
The Crofton and the Fuller keyboards lay their keys flat, parallel with the surface on which they rest, and so are not as easy to use for someone accustomed to a typewriter. The rest of the keyboards are tilted to an angle of











30° by either the case in which they fit or the stand on which they are mounted. The Computer Keyboards keys also rise from one row to the next giving a better spacing and less chance of hitting two keys at the same time. All of the keyboards apart from the Computer Keyboard — which uses a standard QWERTY typewriter layout — adopt the Sinclair layout with extra keys added to each end.

Fuller's extra keys consist of an additional shift key next to the 0 key making it easy to press the two keys to give Rubout and " , and an extra Newline key next to the A key allowing you to press the shift and Newline together to give Function. As these are in use all the time, this could prove most useful.

Crofton has provided 11 extra keys marked with Break, Edit etc., to save you hunting for them. They still have to be used with shift otherwise they just produce their normal code. The Crofton and the Computer Keyboards are the only ones with space bars, but the Crofton one is rather small.

Additional keys

The Computer Keyboards product has six spare keys which could be used to duplicate another key, but because they are the same type as the rest of the keys they cannot be used as on/off switches.

The Kayde and d'Ktronics keyboards provide a repeat key which interrupts the output lines from the keyboard five times a second. To the ZX-81, this looks as though you are pushing the keys on/off very quickly, even though you have the key down permanently. This requires components to be mounted on the keyboard which need a power supply from the ZX-81.

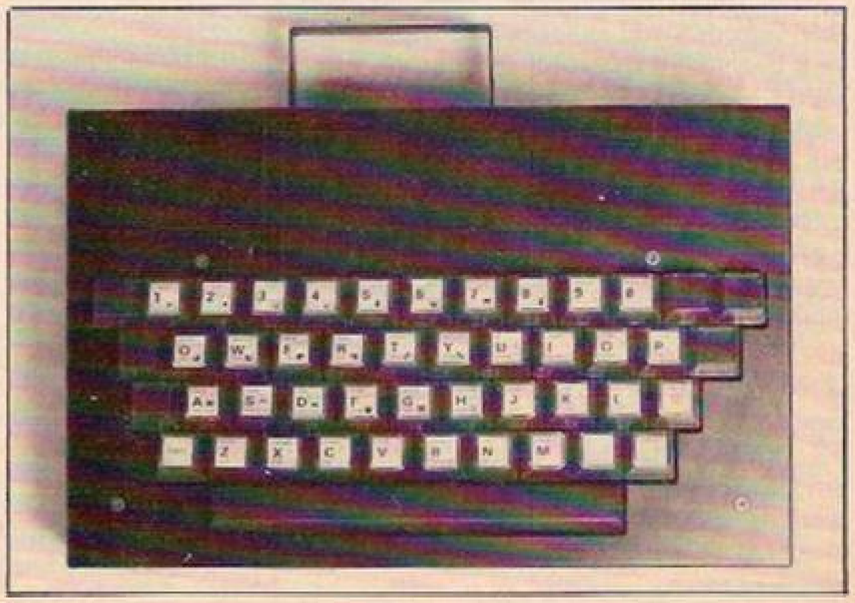
The cases supplied with the keyboards were all big enough to hold the ZX-81 printed-circuit board. Redditch does not, however, recommend that this be done with its version.

The ZX-81 fits tightly into the Computer Keyboards matt-black, aluminium case and a metal strap is even provided at the back to hold the 16K RAM pack in position.

The Crofton case does not hold the ZX-81 printed-circuit board at all and it is attached only to the keyboard. This causes even more vibration to the 16K RAM pack than usual. There are pillars which could have been used to mount it more firmly, but the holes have

(continued on next page)





(continued from previous page)

not been drilled in the case to take the screws.

The Crofton board also supplies a video amplifier output for a monitor and although it is good for those who think that a monitor gives a better picture, it degrades the TV signal so much that it cannot be used.

The Fuller keyboard's case can be used to house a complete system which can be expanded as desired with up to four internal edge connectors, 64K RAM, power supply and two 250V mains power-supply sockets for cassette or TV. All of this is contained in a 14in.-by-8in.-by-3in. injection-moulded plastic case, which has a LED power indicator. The only reservations I have are about the edge connectors, which only allow boards 2in. high to be connected to them.

The Peter Furlong Workstation is an ABS plastic shell which will house all the wiring associated with a ZX-81 and tilt the TV at an acceptable angle.

The plinth houses the ZX-81 and 16K RAM pack in a well at the front and the wiring to the Sinclair disappears through the side of the plinth to reappear at the back. If you are still using the original Sinclar leads for the cassette and TV, then additional holes will have to be cut at the side.

Crofton

A flat steel box which houses a keyboard, a video amplifier and the ZX-81. It is of little use unless you need to operate with a video monitor and can secure the 16K RAM pack in some other way. Cost: £42.70 including VAT and postage.

Kayde

The keyboard is heavy compared with most and will soon have a case which should prove a great improvement. The key symbols are attached with adhesive, and can fall off very easily. The repeat key is an attraction, but the instructions for soldering the keyboard cable need to be clearer. Cost: £27.95 ready-built.

Protos

The Protos system 40-key keyboard is mounted on a heavy steel plate. The keys have removable tops, which cover multicoloured versions of the Sinclair symbols. The green and brown backgrounds do not make the symbols easy to see, particularly if you are colour blind.

The case arrived in seven pieces, six more than intended, and although it is supposed to be a heavy-duty keyboard, some of the nylon pillars had snapped. The keyboard was well wrapped to protect it from the postman so I can only assume it was the heavy steel plate which did the damage.

The ZX-81 must be removed from its case and placed inside. The edge connector of the ZX-81 plugs into a suitable connector via ribbon cable to another printed-circuit board mounted on the case. This board appears through the slot at the right-hand side. All the tape connections are plugged into the ZX-81 via holes at the back. Although it looks attractive I cannot see this Frome system working well with the ZX-81 as it is expensive, £67.75 including post and VAT, and awkward to use.

Computer Keyboards

As the firm's name suggests, the ZX-81 is not the only computer for which it produces a keyboard. It is properly tilted, and has a ZX-81 type QWERTY keyboard with space bar. Even when not mounted in a case it is at the correct angle and the stepping of the keys lends it a professional finish. The connection to the ZX-81 is via copper-coated strips which plug into the ZX-81 sockets. The case contains the ZX-81 and a strap has been provided to stop RAM wobble. This, in my view, is the best of the keyboards reviewed, so probably worth the extra expense. Cost: kit, £28.95; ready-built, £31.40; case, £15.

Work-station

This is useful when you have to keep all the cables out of the way, in a position reserved for the ZX-81. The TV might prove too near the eyes for some, and the Sinclair printer needs to have modifications made to the plinth. Cost: £18; power switch, £3; cassette change-over switch, £3.50; aluminium floor, £4. All prices include VAT and postage.

Fuller FD System

The keyboard for this system provides a cheap start to forming a quite comprehensive layout for the ZX-81. The keyboard is not the best available, but it has some useful facilities. I would recommend this as a portable system for demonstration use, as all the equipment required, apart from the TV and cassette recorder, can be packed in one case. Cost: kit, £19.75; ready-built, £25.75 for the plain 40-key version; £35.45 for the 42-key version in the case; £43.45 for a ready-built model; motherboard with two edge connectors, £16.75; three edge connectors, £21.75; four edge connectors, £26.75, all of which are ready-built; 64K RAM Pack, £45; 16K version which can be upgraded to the 64K version, £35.95; both are ready-built; 9V power-supply unit, £6.75; 12/5V for £13.95. Various other switches and sockets are available. There have been reports of considerable delays in delivering this keyboard so, before ordering it, it is worth ensuring that you have written confirmation of an acceptable delivery time.

Clockwise from top; Dean Electronics Computer Keyboard; Fuller FD System; Redditch; d'Ktronics; Kayde; and Crofton Adaptakit. Centre; Peter Furlong Work-station.



d'Ktronics

A pleasant keyboard, mounted at the correct angle, with repeat facility. The instructions are clear with a section on faults that can occur. The keyboard has to be soldered to the ZX-81. A numeric pad can be connected next to the keyboard on the right as shown in the accompanying photograph. Cost: £27.95; numeric keypad, £10.

Redditch

An easy-to-use 40-key keyboard, less expensive than most, but requiring a case to make it tilt to the correct angle. The connection to the ZX-81 is via two plugs, and very clear, simple diagrams make it easy for those concerned about harming the computer. Cost: kit, £20.50; ready-built, £27.75; £10.30 for the case.

ADDRESSES

Suppliers

Crofton Electronics Ltd: 35 Grosvenor Road, Twickenham, Middlesex TW1 4AD. Telephone: 01-891 1923/1513.

Kayde Electronics Systems: 48/49 Exmouth Road, Great Yarmouth, Norfolk NR30 3DP. Telephone: 0493-55253.

Redditch Electronics: 21 Ferney Hill Avenue, Redditch, Worcestershire B97 4RU. Telephone: 0527-61240.

d'Ktronics: 23 Sussex Road, Gorleston, Great Yarmouth, Norfolk. Telephone: 0493-602453.

Computer Keyboards: Glendale Park, Fernbank Road, Ascot, Berkshire. Telephone: 0347-4731.

Peter Furlong Products: Unit 4, South Coast Road Trading Estate, Peacehaven, Sussex.

Fuller Micro Systems: The ZX Computer Centre, Sweeting Street, Liverpool 2. Telephone orders: 051-236 6109.

Frome Computing: 20 Ashtree Road, Frome, Somerset BA11 2SF. Telephone: 0373-71435.

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ALL IN THE

Sleeve notes

- Although the flexi-record is a new way of distributing software, you should remember at all times that the fundamental principle involved is the same as when a program is stored on tape. That is, the electronic binary signals are enshrined in a physical form to be replayed at a later date. It makes no difference to the computer what medium the signals are stored on when it receives them.

- With this in mind, there are two ways you could load your flexisoft disc. The first is to record the disc on to tape, and use the tape just like any other ZX tape. The second method is to load directly from the record player. The first method is best for most people as it requires little or no change in the ordinary tape-loading procedure. Though you will have to experiment with the recording levels as you would with any commercial cassette.

- The best setting on an ordinary music centre is treble zero. If you have to move it, move it up, bass zero, though if you move the bass, move it down — but not too far. I did not use Dolby when recording the disc, but if you do, ensure that Dolby is on when you load the tape. I turned the left channel right down, and set the level of the right-hand channel to zero dB using a level meter. If you do not have any meters, you will have to judge the correct volume either by ear, or by guesswork. It is a matter of courtesy not to play the record too loud as it makes a real din.

- Loading the program directly from the record player should be fine. However you will have to watch that you do not damage your computer. This is easily done if too high a volume is put into the machine. If your record player has a headphone socket or an earphone socket use it. The software does load, although sometimes minor mistakes occur as information is misread. Because of that we reproduce the program listing here for anyone who experiences this problem.

- Remember the program is for an expanded ZX. It will definitely work with the 16K RAM pack and it should be possible to run on an 8K ZX-81. It loaded into a 3K ZX-81, but left no space for the variables.

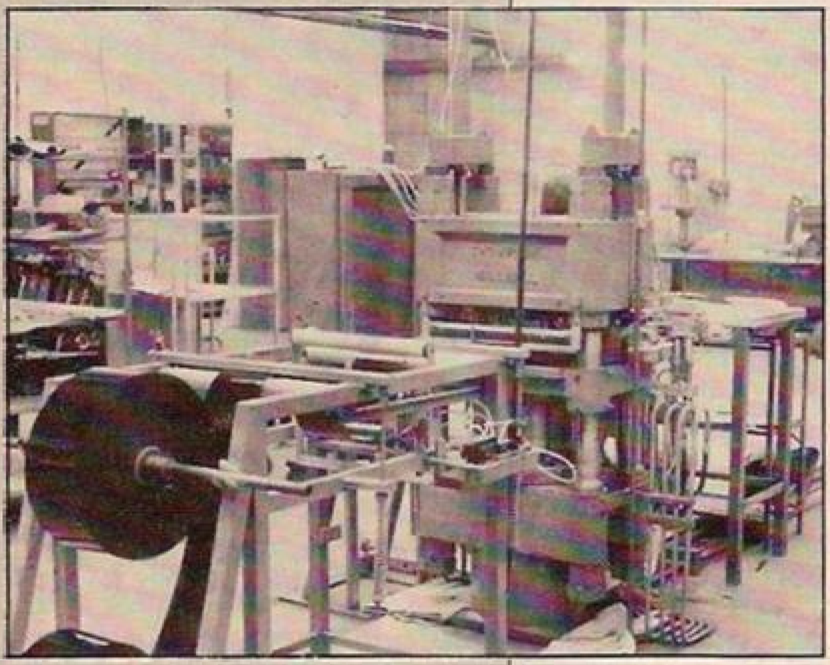
This month's *Your Computer* cover could reduce the cost of recorded software from pounds to pennies. That thin slice of plastic will cause tremors in the software industry. Bill Bennett explains how we put Othello on a flexidisc.

ABOUT 16 MONTHS' talk of distributing software commercially by the new and revolutionary method of putting programs on a flexible disc was temporarily shelved when it was discovered that the then most popular machine, the Pet, did not lend itself readily to the idea.

Then the Sinclair ZX-80 and 81 arrived on the scene. These machines totally changed the face of microcomputing and at the same time transformed the software market. At more or less the same moment as the launch of the Sinclair ZX-81 *Your Computer* appeared on the book-stands, a computer magazine which has always thrived on the volume and quality of correspondence from its readers.

One morning I came across a letter in the *Your Computer* post from Bernard Beeston. He suggested putting some ZX-81 software on to one of "those flexi-record things". At first I just filed the letter for reply. That night I thought about it again and in the morning discussed it with my colleagues.

In short, it was a brilliant idea. Bernard Beeston is a collector of free flexidiscs and on seeing the *Tomorrow's World* television trans-





A roll of black vinyl feeds into the press to be stamped with the program cut into squares and stacked.

Othello program listing

```
   0 REM OTHELLO2 INTERFACE DEC
81 P13 AMENDED BY ROY EASTWOOD
  10 FAST
  20 REM INITIALIZE ARRAYS
  30 DIM B$(2,2)
  40 DIM C$(2,2)
  50 DIM A$(2,200)
  60 REM DRAW BOARD
  70 LET F$="▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒"
  80 LET G$="▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒"
  90 LET K$="[graphics]"
 100 LET H$="[graphics]"
 110 LET J$="■ 2 3 4 5 6 7 8 9  ■"
 120 LET A$(1) =H$+"■ "+F$+" ■ "
+G$+" ■ "+F$+" ■ "+G$+" ■"+F
$+" ■ "+G$+" ■ "+F$+" ■"+G$+
" ■"+J$
 130 LET A$(2) =J$+"■1"+F$+"1■2"
+G$+"2 ■ 3"+F$+"3 ■ 4"+G$+"4 ■5"
+F$+"5■6"+G$+"6■7"+F$+"7■8"+G$
+"8 ■"+K$
 140 LET A$(1,89 TO 92)="■■"
 150 LET A$(2,89 TO 92)="■■"
 160 LET A$(1,109 TO 112)="■■"
 170 LET A$(2,109 TO 112)="■■"
 180 LET D$="BCDLNVWX"
 190 LET E$="▓ FAST THEN ▓ASN ▓
STOP SGN ▓ STEP ATN ▓INT ▓
SIN LPRINT ▓""▓LLIST LN TAB EXP
▓VAL ▓ACS ▓LEN **▓CHR$ OR
▓SQR ▓T NOT USR ▓ SLOW ▓TO
<=STR$ ▓ AND ▓"
 200 PRINT AT 1,6;
 210 FOR A=1 TO 161 STEP 20
 220 FOR D=A TO A+19
 230 PRINT A$(1,D);
 240 NEXT D
 250 PRINT TAB 6;
 260 FOR D=A TO A+19
 270 PRINT A$(2,D);
 280 NEXT D
 290 PRINT TAB 6;
 300 NEXT A
 310 PRINT AT 8,0;"ME:■";TAB 26;
"YOU:■ ";TAB 3;"■";TAB 30;"■"
 330 SLOW
 340 REM DECIDE WHO IS TO MOVE
 350 IF RND>.5 THEN GOTO 690
 360 REM COMPUTERS MOVE
 370 LET B$(1)="■"
 380 LET B$(2)="■"
 390 LET C$(1)="■"
 400 LET C$(2)="■"
 402 PRINT AT 21,0;"
                               "
 410 FOR K=1 TO 60
 420 LET B=CODE E$(K)-140
 430 IF A$ (1,2*B)<>"▒" AND A$(1,
2*B)<>"▒" THEN GOTO 650
 440 LET H=0
```

GROOVE

mission of the ZX program, he hit on the idea of putting ZX software on flexible records.

Not long after receiving the letter from Beeston, another event occurred which pushed the idea further forward. I discovered that the signals used by the Sinclair computers to store information on tape were not only in the audio range, but exceptionally well suited to recording on flexidisc. We simply had to go ahead and test the idea.

Simple method

The ZX-81 — and for that matter the ZX-80 — uses a particularly simple method of storing information on cassette. The zeros and ones that make up the binary codes used by the computer are stored as simple sine waves. A zero is represented by a sine wave of a given number of cycles; a one is stored as a wave of another number of cycles. Between the individual bits is a short blank, which is about as long as the one-bit sine wave in time.

This information is stored serially on a cassette, and is loaded simply and relatively quickly into the memory of the micro at 300 baud. The signals are recorded on ordinary cassette tape, in exactly the same way as a musical signal would be. This is very helpful because in the same way that, for example, a pop group would record their music initially on tape before transferring it to disc, the ZX-81 software can be transferred from cassette to disc.

In fact, the practice is somewhat more complicated than the theory, as I discovered when I went along to the cutting studios. The studio where we made the initial software record looked like the bridge of the Starship Enterprise. Around the side of the room were all kinds of cassette players, recorders and amplifiers. In the middle was a desk, covered with mixers and various pieces of noise-reduction equipment.

Among the hyper-modern hardware was an apparatus which resembled a microcomputer — in fact it was an audio analyser, which projects a display of the audio spectrum on a screen. Each frequency band within that spectrum is represented by a vertical bar, which waxes and wanes with the quantity of that frequency present in the sound.

Like dancing spirographs

In addition a cathode-ray tube display showed Lissajous figures. These are rather interesting displays which show the relation between two harmonically varying signals. They look rather like dancing spirograph drawings. All this equipment was very impressive but it was there for a reason: it told us that superimposed on the ZX-81's output signal were a number of other signals.

These signals normally do not make any difference to the loading of programs on the ZX-81 as there is a very wide tolerance. However, with the recording of software on to disc, we were entering unexplored territory and had to be careful.

The computer signal sits somewhere in the ordinary audio spectrum, at around 3kHz to 4kHz. Being a sine wave, it should not have any other frequency components. The sine wave, if pure, does not contain any other components because it is the fundamental component itself. If it is amplified too much, the peaks are clipped and the wave begins to look like a square wave — which, incidentally, is how a guitar fuzz-box works.

The reason this is important to microcomputers is that when a sine wave is distorted into a square wave, other frequency components are introduced which confuse the computer. This is what sometimes happens when a ZX program is Saved or Loaded too loudly.

There were two main sources of sound present on the master tape of the text program, other than the computer signal wanted. This master tape was made by recording directly from the program cassette to a reel-to-reel tape recorder. These sources of extraneous sound are referred to as "noise" by audio engineers.

Two types of noise

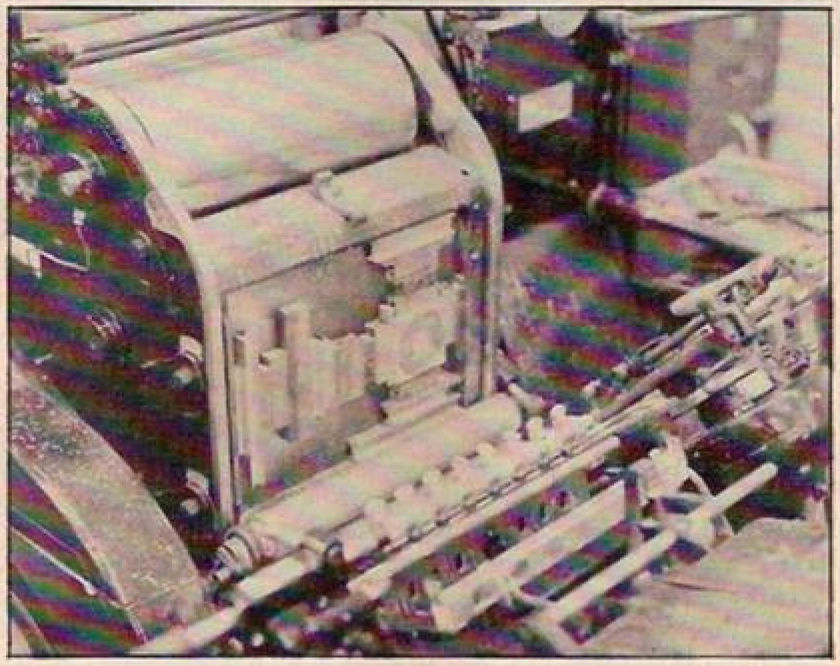
The original flexidisc test tape had two types of noise on it. Later, I discovered that more or less all Sinclair tapes have these types of noise because of certain factors associated with low-cost tape recorders, and we all know that the chaper tape recorders work best with the Sinclair.

The first type of noise was the background noise of the cassette itself. I do not want to become too involved with the technicalities, but cheap, standard, cassette tape has a background hiss, which is mainly at the higher end of the audio spectrum.

The other noise was one picked up from the recorder itself, probably due to the motor.

(continued on next page)





The squares are trimmed into discs and the Your Computer *labels are then printed directly on to them.*

```
 450 FOR X=1 TO 8
 460 LET N=CODE D$(X) -50
 470 LET E=0
 480 LET F=B
 490 IF A$(1, (F+N)*2) <>B$(1,2) T-
HEN GOTO 530
 500 LET E=1
 510 LET F=F+N
 520 GOTO 490
 530 IF A$(1,(F+N)*2) <>C$(1,2)O
R E=0 THEN GOTO 630
 540 FOR A=B*2 TO F*2 STEP N*2
 550 LET A$(1,A-1 TO A) =C$(1)
 560 LET LINE=1+2*INT ((A-1)/20)
 570 LET COL=4+A-20*INT ((A-1)/20)
 580 PRINT AT LINE, COL;C$(1)
 590 LET A$(2,A-1 TO A) =C$ (2)
 600 PRINT AT LINE+1, COL;C$(2)
 610 LET H=1
 620 NEXT A
 630 NEXT X
 640 IF B$(1) ="▛▜" OR H=1 THEN GOTO
660
 650 NEXT K
 660 IF B$(1) ="▛▜" THEN GOTO 370
 670 IF H=0 THEN GOTO 780
 680 REM HUMANS MOVE
 690 LET B$(1)="▛▜"
 700 LET B$(2)="▙▟"
 710 LET C$(1)="  "
 720 LET C$(2)=" █"
 722 PRINT AT 21,0; "ENTER MOVE E.G.
19 (0 FOR SCORE)"
 730 INPUT B
 740 IF B=0 THEN GOTO 780
 750 IF A$(1,B*2)<>"▩" AND A$(1,B*2)
<>"▩" THEN GOSUB 1010
 760 GOTO 440
 770 REM CALCULATE SCORE
 780 LET CP=0
 790 LET HP=CP
 800 FOR A=23 TO 177 STEP 2
 810 IF A$(1,A)= "▛" THEN LET CP=CP+1
 820 IF A$(1,A)= "▪" THEN LET HP=HP+1
 830 NEXT A
 840 PRINT AT 10,0;CP;TAB 27;HP
 850 IF CP+HP<64 THEN GOTO 690
 860 IF CP>HP THEN PRINT AT 21,0;"
              I WIN              "
 870 IF CP<HP THEN PRINT AT 21,0;"
             YOU WIN             "
 880 IF CP=HP THEN PRINT AT 21,0;"
              DRAW               "
 890 STOP
1000 REM INVALID MOVE
1010 PRINT AT 13,0;"CHEAT*";TAB 0;
"IF YOU";TAB 0; "DO IT"; TAB 0;"
AGAIN"; TAB 0;"I WONT";TAB 0;"PLAY"
1020 LET B=0
1030 RETURN
```

(continued from previous page)

Another source of noise is the stretching of the tape and a fourth could be due to mechanical imperfections on the cassette itself.

The random-noise part of the signal — that is, the background hiss — was reduced by a Dolby system. The lower tones associated with the tape drive were harder to eliminate, but the worst of it was removed by a graphic equaliser. The original test tape was recorded in stereo, but the flexi-record you will have received with this copy of *Your Computer* was recorded in mono.

This treated signal was then stored on a length of open-reel tape. The beginning of the program and the end were marked on the tape by cutting it at the relevant point and then inserting a short stretch of yellow tape. The whole was then reloaded on to the tape deck ready to cut the disc.

Disc-cutting machine

The disc-cutting machine looks just like a record player — one of the very expensive stereo variety. Yet, unlike the machine that it so closely resembles, it does not play records but cuts them. This is done by making the stylus vibrate in the disc material as it tracks towards the centre of the disc. The process is just like playing records, but in reverse.

The material that the disc is cut into is called an acetate. It looks just like an ordinary black 12in. record, except it has neither label nor groove — at least to begin with. The turntable is rotated at the set speed, with the acetate firmly clamped to it. The initial "run-in" groove is cut, and the turntable stops. Then the tape machine is cued to the beginning of the software. At the same moment as the tape machine begins to play, the record cutting starts automatically.

It is possible to set an adjustment that governs the pitch of the grooves, that is the amount of material that is left between the gaps. Ordinarily the more of this, the better the quality of the recording. This is because the stored sounds of one groove can impose themselves on another if the walls between them are not sufficiently wide. Of course, the optimal setting of this adjustment is one which utilises all the available material between the edge of the record and the point where the stylus picks up.

The acetate platter which has the record cut into it is 12in. across, but the record is only the 7in. in the middle. Once the acetate is cut, a label is stuck on the middle, and the acetate disc can be played just like an ordinary record. To test the process, this is just what I did.

I decided the best thing to do would be to tape the program on the disc and play it just like an ordinary piece of software. I made a number of different recordings, some in stereo, some in mono, some with treble turned full on and some with the settings all at zero. The software loaded, but not when it was recorded in stereo; the flexidisc you have is in mono.



Under the microscope a series of short white lines and spaces show up in the grooves. This is the form in which the binary digits are encoded on the flexidisc.

The master, which is another name for the acetate disc, for the *Your Computer* flexidisc was cut at Pye recording studios in London between takes of the new Tight-Fit record. Most of the pop stars wandering in and out of the studio would probably have covered their ears in disgust if they heard the disc. Listen for yourself and hear what it sounds like. However, to the ears of Tony Bridge, the engineer who cut the disc, the sound was music because he is a ZX-81 user. It was very useful having someone who understood computers working on the disc.

Once the master disc is cut it is plated in metal. The metal plates are then pulled away and become the stampers that are used in the flexi-record factory. The flexi-record factory at Charlton, south-east London, turns out records by the hundreds, usually of pop music, or maybe an advertising message. They have even made records for use in by-election campaigns.

The process used to make the records was explained to me by managing director John Moon. One of the most important features of producing flexi-records is the vinyl on to which the discs are stamped. This is available in a number of different thicknesses and colours — it can even be metallic gold or silver. Black is, however, the usual choice because it looks like ordinary records.

A special design

The vinyl is held in huge reels which are mounted on an axle behind the flexi-record press. The press is of a special design, built and designed by the directors of Flexi-records themselves.

Normally the stampers push out four discs at a time. The key to making good flexi-records is the hole in the middle, which is punched out at the same time as the actual stamping. The records are then cut, and stacked on a spike. At this point the records are still square.

They are loaded, a bundle at a time, on to a cutter, which works in the same way as a pastry cutter. The last stage in the process is when the labels are printed directly on to the flexi-record. This is done with a Heidelberg printer, which is a pleasure to watch.

Of course, a large sample of the flexidiscs were tested, and they all worked. So all that remained for us to do was to put the discs into the magazine and distribute them throughout the country. I hope you manage to beat the computer at Othello or Reversi. ■

How to play Othello

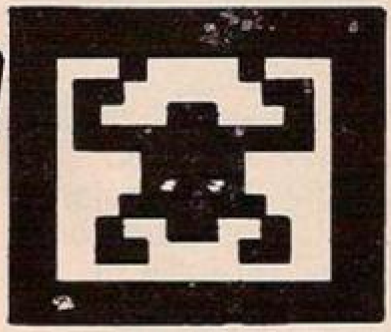
Othello, which was originally called Reversi, is a board-game for two players, played on a conventional chessboard with eight-by-eight squares. The pieces are double-sided, coloured black on one side and white on the other. Any of the opponent's pieces in a straight line between the last piece played and another of the player's pieces is "captured", that is to say turned over, to convert it to the player's colour. The game finishes when the board is covered with pieces or when neither player can move, and the winner is the player with the most pieces at that stage.

If the program has loaded correctly then a grid of eight-by-eight squares will appear, just like a chessboard. Along the top will be the numbers from two to nine and down the side one to eight. There are two possible states at the beginning, either it is your go first or the computer's. If it is your go first the computer will prompt you with the message: "Enter Move EG 19 (0 for score)". If the computer is to move first the screen will be dark for a while.

When moving remember to enter the ROW first followed by the column number. Sometimes you can cheat and get away with it. Be warned, if you do the game will finish. Entering a zero will give you the score, do this at the end of the game.

MAZOGS





A MAZE ADVENTURE GAME FOR sinclair ZX81

MAZOGS is a brand new game for the 16K ZX81, unlike any other game you've seen on the ZX81. This is without doubt the best game available for this computer, and if you don't believe us, ask somebody who has seen it, or go down to your local computer shop and ask for a demonstration.

MAZOGS is a maze adventure game with very fast-moving animated graphics. A large proportion of the program is written in machine code to achieve the most amazing graphics you have ever seen on the ZX81.

You will be confronted by a large and complex Maze, which contains somewhere within it a glittering and fabulous Treasure. You not only have the problem of finding the treasure and bringing it out of the maze, you must also face the guardians of the maze in the form of a force of fearful Mazogs. Even if you survive their attacks you could still starve to death if you get hopelessly lost. Fortunately, there are various ways in which you can get help on this dangerous mission.

There are three levels of difficulty, and the game comes complete with comprehensive instructions. The cassette on which the game is supplied is of the highest quality, and loading is guaranteed.

Mazogs is available from Bug-Byte and most good computer shops at £10.00 inclusive.

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INTERVIEW

ADDED EXTRA FOR

Ron Bissell has been in on the explosion in microcomputers from the start. With fellow director Ken MacDonald he has built Macronics up into one of the major ZX soft- and hardware houses. He talks to Brendon Gore.

RON BISSELL first came into contact with computers while in the sixth form. A trip to Wolverhampton Polytechnic introduced him to an early U.S. computer.

"We were allowed to write programs for it, punched on paper tape", says Bissell. "It was a whole wall full of entertainment with flashing neon lights and chattering relays".

After leaving school, Ron Bissell went to Queen Elizabeth College, London in 1962 to do a general-science degree. Unfortunately, he failed his first-year exams, which he attributes to the disruptions caused by leaving home, moving to London and trying to settle down to college life.

Nothing daunted, he found himself a job in the electronics industry with Contactor Switchgear (Electronics) Ltd. He worked in the company's development laboratory building prototype timers, logic circuits and remote-control TV units from schematics. It was very useful experience, he says with just a touch of understatement.

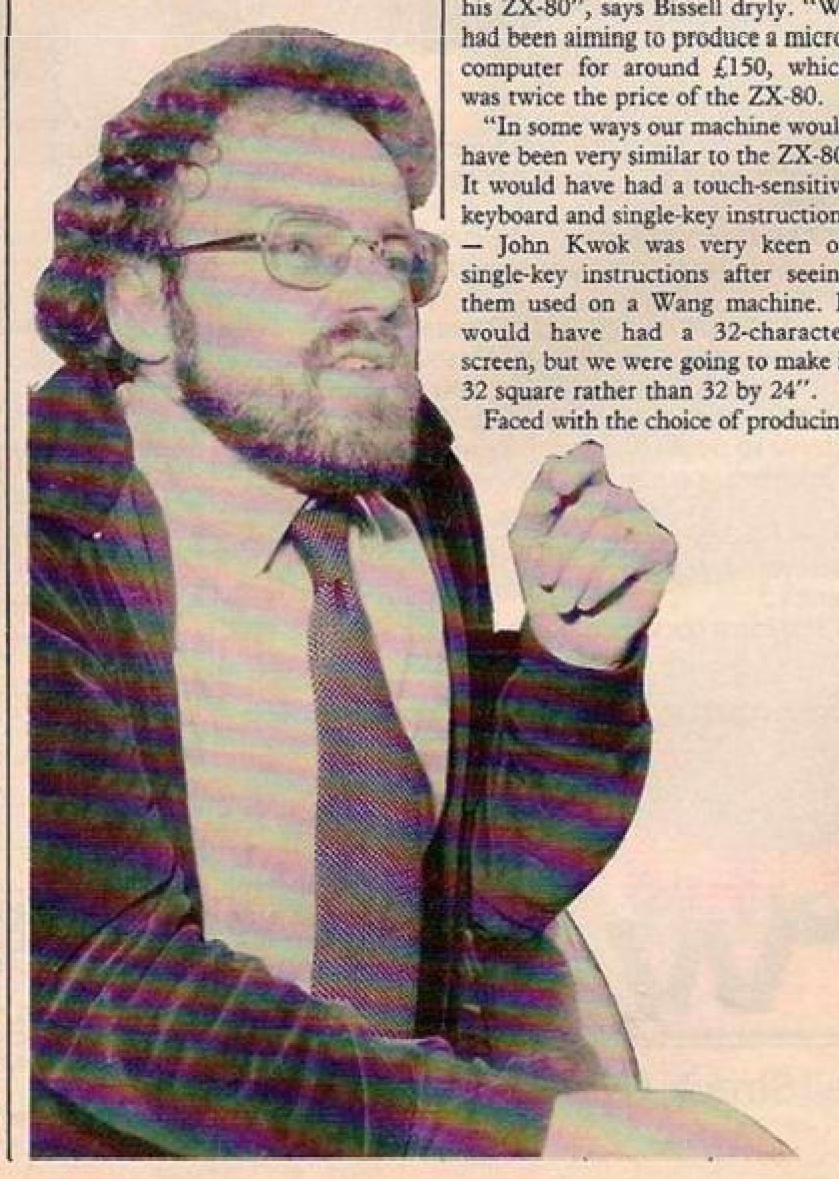
After a year in industry, he sat his first-year exams at Chelsea Town Hall. He remembers it as being surprisingly easy, a pleasant week with beautiful weather. He was a little surprised when he passed, as he was weak in mathematics. But he drew small sketch graphs in answer to most of the questions, and thinks that they must have done the trick.

Having graduated, Bissell started working for British Steel. He was assigned to work with the O/M (Operations and Methods) department on the problem of cutting up steel bars into precise lengths with minimum wastage. He looked at a Fortran program the O/M department had written to solve the problem, and decided that Fortran was not that difficult a language to learn.

A year after joining British Steel, Ron Bissell left the company to join the West Midlands Regional Health Authority. Officially he was part of an O/M department, but within months he was put into the O/R (Operational Research) division. This entailed considerable work with computers.

"I was involved with the setting up of an emergency bed bureau in east Birmingham", says Bissell. "The idea was to stop some hospitals from being swamped with patients while other hospitals had empty beds.

"We had to produce computer forecasts of the likely number of patients expected on any particular day of the year. By combining the seasonal and weekly patterns of admissions, we were able to produce a table of the likely number of patients to be admitted to hospital in the West Midlands on any day of the year".



The origins of Macronics lie in the West Midlands Regional Health Authority. Ron Bissell, Ken MacDonald and John Kwok all worked for the WMRHA, and they were all quick to spot the potential of microcomputers. In 1979 the three of them decided to try and design a cheap alternative to the semi-professional machines they had been working with. However, it became the computer that never was.

'Memory-mapping ZX screens was thought impossible'

"We made the decision to abandon our computer after Sinclair launched his ZX-80", says Bissell dryly. "We had been aiming to produce a microcomputer for around £150, which was twice the price of the ZX-80.

"In some ways our machine would have been very similar to the ZX-80. It would have had a touch-sensitive keyboard and single-key instructions — John Kwok was very keen on single-key instructions after seeing them used on a Wang machine. It would have had a 32-character screen, but we were going to make it 32 square rather than 32 by 24".

Faced with the choice of producing a comparable machine to the ZX-80, but at twice the price, they decided to drop it and concentrate on producing software for the ZX-80: "There were so many limitations in the ZX-80 that there was obviously a need for programs to get round them".

Ron Bissell's first program for the ZX-80 was a memory-map screen display. "Everyone had been saying you could not memory-map the Sinclair screen", explains Bissell. "In fact it was simply a matter of setting it up with blanks on all sides and knowing where it was in memory. This allowed you to Poke to any part of the screen that you wanted, which in turn meant that you could run the kind of games programs that everyone else was running on other machines".

The memory-map program sold for around £1 a listing, says Bissell. For the first six months they sold around 30 listings a week, which was not bad for the first program. But they did have the advantage of not having any competition.

John Kwok had dropped out of the team by this point. "He was more interested in the concept than the actuality", says Bissell. "Besides, he had been made head of the authority's microcomputing development project and he was putting his main efforts into that".

A natural division of responsibilities evolved between the remaining partners. Ken MacDonald looked after the marketing and financial side of Macronics while Ron Bissell took charge of the technical and software side.

The next Macronics program to hit the market was the active-display program. This was designed to get round the fact that the ZX-80 screen was static, so that nothing happened unless a key was depressed. But, by this time the competition was starting to arrive.

"We got our active-display program out at about the same time as Ian Logan produced his version", says Bissell. "The difference between the programs was that his version involved copying whole sections of the Sinclair ROM into memory. That worked well, but it used up a good deal of memory. In our version, we copied the necessary parts of the Sinclair ROM into our program, but without the extras. This meant it needed very little memory. There was some screen

ZX-81



flicker between displays, but at least they would change and update by themselves".

This program went on sale for about £5. It was part of Macronics strategy to sell techniques as well as games, playing on the "look what you can do with your ZX-80 that nobody else can" idea.

The price of the program was something Macronics had learnt through experience. "£5 or £6 was the optimum price for a program", says Bissell, "and it still is. You cannot sell anything for much less because people will think it is rubbish, and you cannot sell any-

'Our micro was to be similar to the ZX-80'

thing for much more because people do not have the money. It does not really matter what is in the program — that is the price for it".

Macronics sold a number of copies of the active-display program, but they were a little disappointed that sales were not higher.

"We do not seem to be reaching the market for some reason. I remember estimating once that we were reaching, at a maximum, two percent of the total number of Sinclair users, which seemed an abysmally low figure".

One possible reason for this lack of early success was the Macronics policy of selling listings rather than cassettes. Bissell and MacDonald felt that listings were cheaper to produce than cassettes and avoided loading problems.

"We did not discover we were wrong in this until we went to a micro show in September 1981. All the people there were asking for cassettes. Purely for psychological reasons, people would rather buy something they could use directly. Through mail order you could sell listings reasonably well, but at shows there was just no way".

Macronics was also writing software for the ZX-81. The first four programs included Dragon Maze and Planetoids. They were conventional Basic programs with little machine code.

"The only machine code I wrote then was a reverse-scroll routine which scrolled down the screen rather than up", says Bissell. "There are problems with the Sinclair scroll in that it changes the length of lines at the bottom of the screen. If you have an array memory which falls above the display file, every time you add something to the bottom line of the screen the whole array memory has to shunt up which takes forever.

"This means you cannot do any fast graphics programs while you have a large amount of data in the variable area. To overcome that I had to write a machine-code routine which did the scrolling but kept the screen its normal size so that nothing was moved around".

But the software market for the ZX-81 seemed less attractive than it had been for the ZX-80: "We saw that there was not much we could do in the way of software that other people could not do equally as well. So we looked at what was coming next, which was hardware".

Macronics first hardware project involved a printer interface. Ron Bissell built a £199 Seiko printer and interfaced it to the ZX-81. The printer interface went on display at another micro show, but although there was some interest in it he has decided to shelve the project for the time being.

"It soon became obvious that the main interest was going to be in an alternative storage method", explains Bissell. "People were producing enormous programs that took the best part of 15 minutes to load,

'Storage media were clearly of major interest'

with no guarantee that they would load, so a different system of storage seemed the thing to concentrate on".

The result was Fiz, which is not a new type of cola but a Floppy Interface for the ZX-81. Fiz consists of a disc drive, power supply and motherboard. The motherboard is fitted with edge connector slots so that the system can be expanded.

"There is a slot in the motherboard for plugging in the ZX-81 processor card, but this entails an external keyboard with the usual external leads", says Bissell. "Many users have external keyboards and that is the best way of doing things.

"The RAM pack also plugs on to the motherboard, but there is no need to use a RAM pack bigger than 16K. Other slots are available for a printer inteface, disc interface, network interface and a high resolution VDU card".

With the Fiz costing £259 plus VAT, it is possible to buy a complete disc system for less than £350. Ron Bissell admits that no one is likely to buy his disc system from scratch, but he thinks there is a market among schools and small businesses that have already bought a ZX-81.

"If you are buying a disc system as a disc system, the last thing you would buy is a ZX-81. You would buy something like a Zerox. But if you already have a ZX-81 and have bought £400 worth of hardware and programs, as many people have done, then you do not want to let go of it. That is the demand we are supplying." ■

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THE WAR MACHINE

...keeps you in touch

Launched in July 1981, **The War Machine** was the first magazine dedicated to computer gaming and has become essential reading for those following developments.

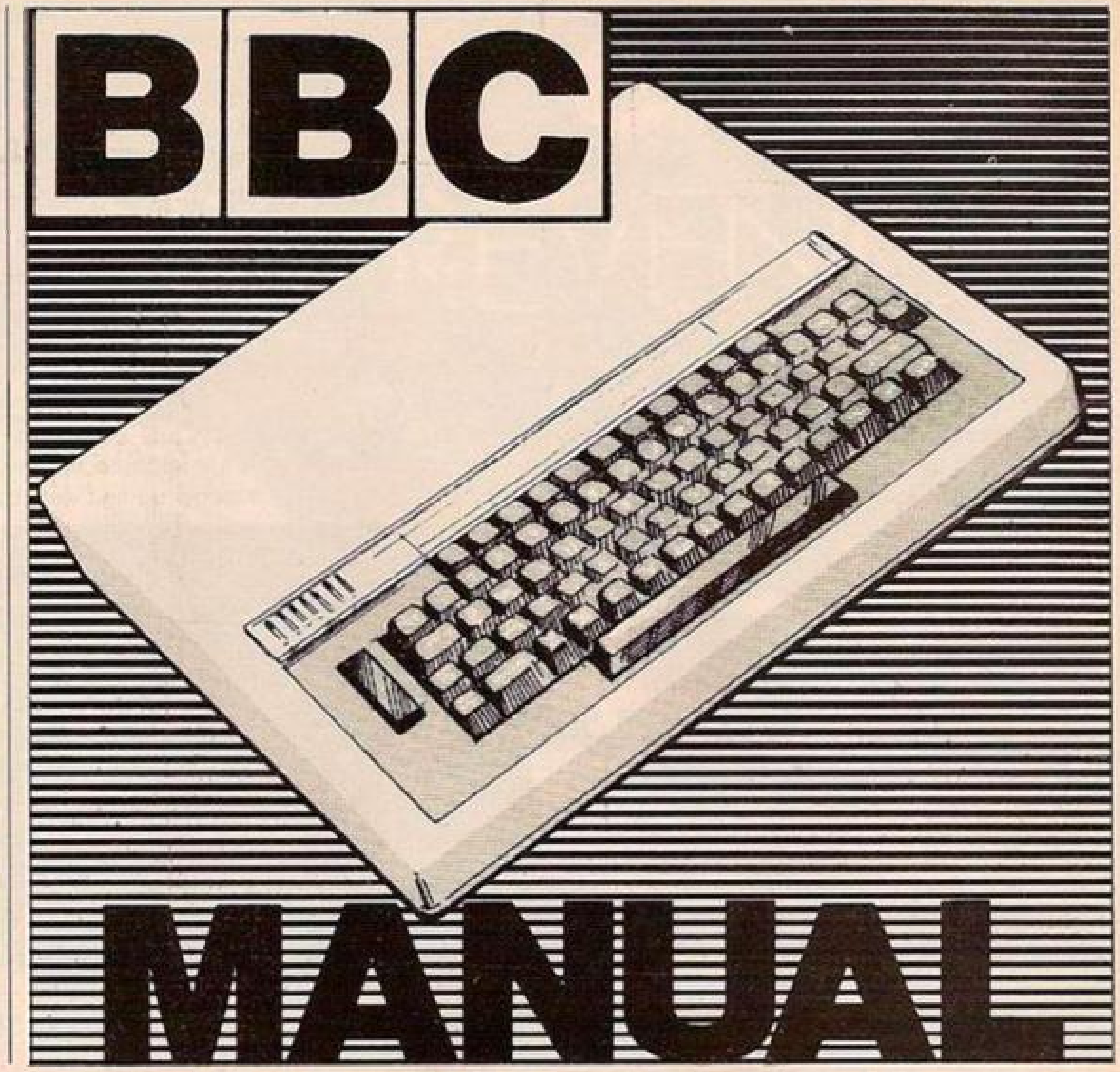
Independent reviewers cover the latest computer-assisted wargames and fantasy role-playing/SF games. Leading software authors describe the techniques they use to develop their programs, and details are given for converting programs from one brand of micro to another. Readers in eight countries share details of the game-assistance programs they have written.

The emphasis is placed on games with lasting play-value. For those who would like to write their own games software, articles explain how general-purpose subroutines can be adapted for different makes of computer. The magazine is now moving into more sophisticated applications including the use of Artificial Intelligence techniques to create a computerised game-opponent, and computer-moderated multi-player games.

For a sample copy of **The War Machine**, send a cheque or P.O. for £1.25 to the address below. A 12-issue annual subscription is £13. Overseas subscriptions are handled by airmail and a year's subscription is £20.

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Ben Baruch leads you out of some of the manual's dead-ends and towards the centre of the maze of mysterious BBC functions.



FILLING IN THE GAPS

YOU ARE TRAPPED in a labyrinth called the BBC Microcomputer. You have no previous experience of this or any other labyrinth, and so have only two possible means of escape: get up and walk away — that sounds easy, but most find it impossible in practice; alternatively you work out how to write programs which look as good as Kingdom and Keyboard — two of the best programs in the manual.

You begin perhaps to write programs with pretty pictures in Mode 5, which seems — according to the *Guide* — to be the only way to obtain multicoloured graphics on the Model A. Yet as soon as a program becomes interesting, you run out of memory. You then may start to find ways of compressing the program — putting as many instructions as possible on one line is a help — but that takes you little further and, besides, now you cannot even follow your own program. Kingdom is much longer than anything you have written, so how does that fit into the labyrinth?

Kingdom and Keyboard are written in Mode 7, which gives you five times as much memory to play with and Mode 7 has colours and graphics and special effects. To obtain colours type:

```
PRINT TAB(5,10)CHR$(&81) "This is red"
```

Press return — and red it is. The instruction

```
PRINT CHR$(&8x)
```

will affect everything on that print line — x is the logical colour. To set up a second colour change in the line, use +. Thus

```
10 PRINT TAB(1,10)CHR$(&81)"This is red"
   +CHR$(&83);
20 PRINT "and this is not"
```

will give you red and yellow in the same line.

Chr$(141) will give you half of a double-size character. So

```
10 PRINT TAB(5,1)CHR$(141);CHR$(&83)
   "Hallo there"
20 PRINT TAB(5,2)CHR$(141);CHR$(&83)
   "Hallo there"
```

will give you a cheery greeting when you Run.

Mode 7 graphics are produced by using Chr$(&9x) instead of (&8x). Upper-case characters will be printed in colour, but in place of lower-case characters, numbers and other symbols — except " and @ and small arrows — you will obtain block graphics in the colour chosen. The letter space becomes a grid of six cells, two wide and three high, and each character fills in one or more of the cells. Chr$(&FF) fills all six. Thus for example,

```
PRINT CHR$(&92)"5"
```

will print a rectangle one character high, half a character wide and coloured green, which is logical colour 2. A list of what each character does is shown in figure 1.

Since provisional users are left in silence by the guide, try:

```
SOUND 1,-10,450,7
```

1 is the sound generator to be used; there are four, numbered 0 to 3: 0 gives a kind of white noise, the others give pure tones; -10 is the volume which can be anything from 0 to -15; 450 is the frequency; and 7 is the duration of the note.

For a chord, each note must be preceded by &a0, where a is the number of other notes in the chord. For example,

```
SOUND &201,-10,300,7
SOUND &202,-10,320,7
SOUND &203,-10,340,7
```

will give a three-note chord. ■

1	2
3	4
5	6

This is how a letter-space is treated by MODE 7 graphics

To fill cells	6,1	6,2	6,2,1	6,3	6,3,1	6,3,2	6,3,2,1	6,4	6,4,1	6,4,2	6,4,2,1
Print	a	b	c	d	e	f	g	h	i	j	k
To fill cells	6,4,3	6,4,3,1	6,4,3,2	6,4,3,2,1	6,5	6,5,1	6,5,2	6,5,2,1	6,5,3	6,5,3,1	
Print	l	m	n	o	p	q	r	s	t	u	
To fill cells	6,5,3,2	6,5,3,2,1	6,5,4	6,5,4,1	6,5,4,2	6,5,4,2,1	6,5,4,3	6,5,4,3,1			
Print	v	w	x	y	z	¼	|	¾			
To fill cells	6,5,4,3,2	5	5,1	5,2	5,2,1	5,3	5,3,1	5,3,2	5,3,2,1	5,4	5,4,1
Print	÷	0	1	2	3	4	5	6	7	8	9
To fill cells	5,4,2	5,4,2,1	5,4,3	5,4,3,1	5,4,3,2	5,4,3,2,1	4	4,1	4,2	4,2,1	
Print	:	;	<	=	>	?	(	)	*	+	
To fill cells	4,3	4,3,1	4,3,2	4,3,2,1	3	3,1	3,2	3,2,1	2,1	1	
Print	,	–	.	/	$	%	&	'	£	!	

Figure 1. The full list to explain the function of each character on the BBC Micro.

Wreak a terrible revenge on the Martians who dared attack Earth when you launch your counter-attack with Paul Edmond's Vic-20 space game in Basic for the unexpanded machine.

MARS IS AN arcade-type game for an unexpanded Vic. Aliens, in the form of club signs, build up from the bottom of the screen and by moving your ship at the top of the screen and firing, these aliens can be exterminated, scoring two points each. Time and score are displayed at the bottom of the screen under the baseline. Missiles are occasionally launched by the swarming aliens; these can be hit for a bonus of five. However, you must dodge from their path quickly — they are indestructible and can steal 20 points from your score.

Owners of the 3K RAM expansion cartridge will be able to unleash their artistic talents to create their own graphics characters for the aliens and missiles by using the high-resolution graphics explained in the October issue of *Your Computer*.

A handy Peek for the Vic is Peek(653). It can be used to detect whether the shift, Commodore, or control keys are being depressed. For example,

```
10 B = PEEK(653)
SHIFT KEY; B = 1   COMMODORE KEY; B = 2
SHIFT + COMMODORE KEY ; B = 3
CONTROL KEY ; B = 4
```

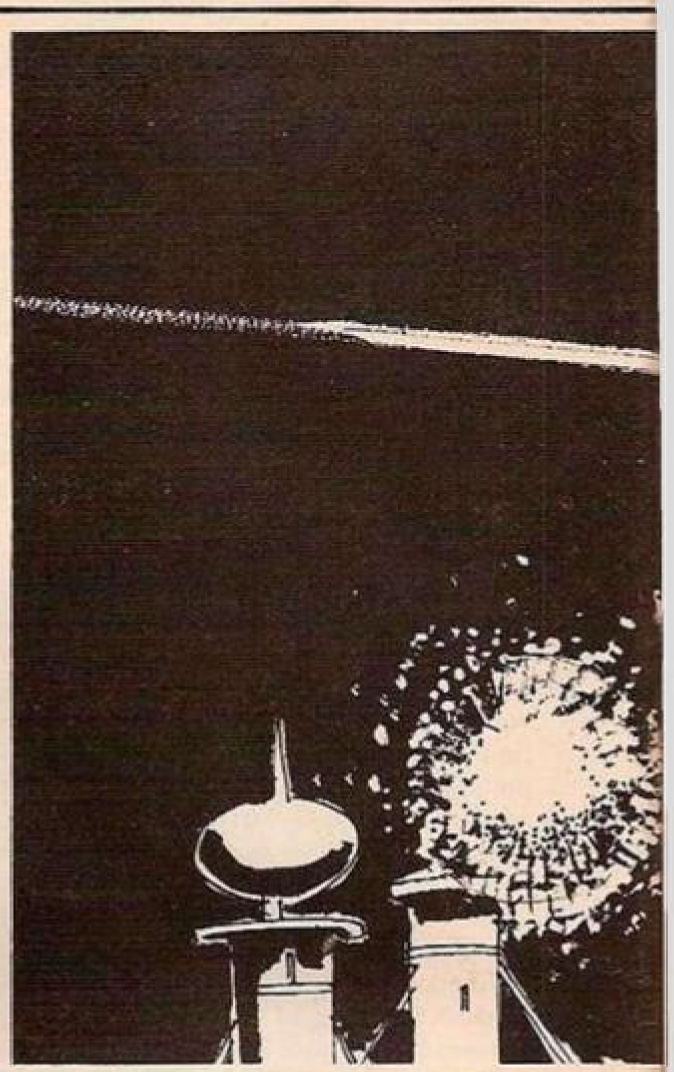
Since this is independent of Peek(197) — used for the rest of the keyboard — it enables some keys to be used for left/right motion through Peek(197) and the shift key for, say, acceleration through Peek(653) without the two sets of controls interfering.

Try adding this to line 430, reduce the M loop to 7 and fit in the Poke statement as shown:

```
430 FOR M = 1 to 7: POKE 36865,
  35+RND(1)*6 :NEXT M,T
```

36864 and 36865 control the X and Y positions of the screen window. This addition to line 430 simply jiggles this window up and down.





```
READY.

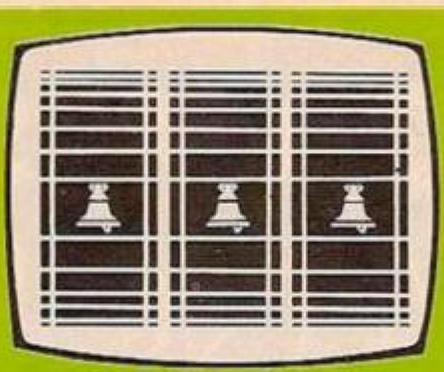
 1 TI$="000000":POKE36878,15:POKE36879,8
 2 DIMA(22):GOSUB800
 3 Z1=7680+19*22
 5 PRINT"{CLR}":Z=7680:PRINT"{HOME}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}{RVS ON}TTTTTTTTTTTTTTTTTTTTTT{RVS OFF}"
 6 FORI=1TO22:A(I)=1:POKE7680+22*22+I-1,121:NEXTI
 7 PRINT"{HOME}{DOWN}{DOWN}{DOWN}{DOWN}HANG ON!"
 8 FORY=0TO505:POKE38400+Y,INT(RND(1)*7)+1:NEXTY
 9 POKE36879,8:PRINT"{HOME}{DOWN}{DOWN}{DOWN}{DOWN}          "
 10 G=PEEK(197):RT=0
 11 IFRND(1)<.3THEN19
 12 D=INT(RND(1)*22):RT=RT+1:IFRT=4THEN19:IFA(D)=0THEN12
 13 A(D)=0:R=R+1:IFR=15THENZ1=Z1-22:FORI=1TO12:A(I)=1:NEXTI:R=0
 14 POKEZ1+D,88
 19 IFTI$>"000130"THEN200
 20 IFG=29THENX=X-1
 21 POKE36877,0
 22 IFR/2=INT(R/2)THENPOKE36877,220
 23 IFL>0THEN300
 24 IFRND(1)>.9THEN300
 30 IFG=37THENX=X+1
 31 IFX<0THENX=0
 32 IFX>21THENX=21
 40 POKEZ+X1,32:X1=X
 50 POKEZ+X,81
 59 IFG=32THEN80
 60 PRINT"{HOME}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}{DOWN}                    {UP}SCORE"SC"TIME "RIGHT$(TI$,
4)
 61 GOTO10
 80 FORI=1TO19
 81 POKE36876,244-I*4
 85 IFPEEK(Z+X+I*22)=88THENSC=SC+2
 86 IFPEEK(Z+X+I*22)=65THENSC=SC+5:POKE36879,0:FORP=1TO80:NEXTP:POKE36879,8
 90 POKEZ+X+I*22,93
 100 IFI>1THENPOKEZ+X+I*22-22,32
 110 NEXTI:POKE36876,0
 120 POKEZ+19*22+X,32:GOTO60
 200 POKE36877,0:FORR=1TO5:PRINT"{CLR}{DOWN}{DOWN}{DOWN}{DOWN}   YOU SCORED"SC
 210 FORU=1TO80:NEXTU
```

GAMES

MARS REVENGE

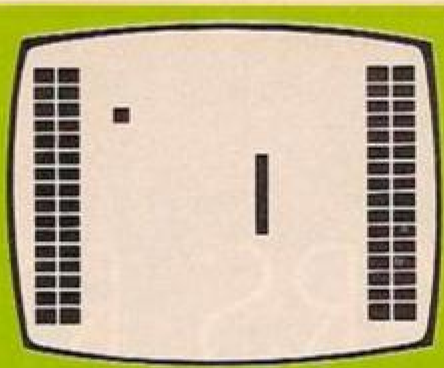


```
220 PRINT"      YOU SCORED"SC
230 FORU=1TO80:NEXTU
240 NEXTR
250 PRINTCHR$(142):FORU=1TO100:NEXTU:POKE197,64:RUN
300 IFL=0THENQ=X
311 POKE36875,128+2*L
320 IFPEEK(Z+22*20-L*22+Q)=81THEN400
330 IFL>1THENPOKEZ+22*23-L*22+Q,32
340 POKEZ+22*19-L*22+Q,65
350 IFL>18THENL=0:POKEZ+Q,32:POKE36875,0:GOTO30
355 POKE36875,0
356 L=L+4
360 GOTO30
400 POKEZ+Q,42:POKE36877,220:POKE36879,0
410 FORT=15TO1STEP-1
420 POKE36878,T:POKE36879,8
430 FORM=1TO80:NEXTM,T:POKE36878,15:POKE36877,0:SC=SC-20:GOTO330
800 PRINT"    WANT INSTRUCTIONS?"
810 GETA$:IFA$=""THEN810
820 IFA$="N"THENPRINTCHR$(142):GOTO3
825 PRINTCHR$(142)
830 IFA$<>"Y"THEN810
831 POKE36879,8
835 PRINT"ALIENS WHICH ATTACKED EARTH HAVE RETREATED  TO MARS.
"
840 PRINT"YOUR TASK IS TO KEEP  THEM THERE UNTIL        FURTHER HELP A
RRIVES."
850 PRINT"WATCH OUT FOR THE      DEVIOUS MISSILES!"
860 PRINT"      HIT ANY KEY"
870 GETA$
871 IFA$<>""THEN875
872 FD=FD+FT:IFFD>9THENFT=-1
873 IFFD<1THENFT=1
874 POKE7680+5*22+FD-FT,32:POKE7680+5*22+FD,88:GOTO870
875 PRINTCHR$(142)
880 PRINT"<-MOVES YOU LEFT>-MOVES YOU RIGHT'SPACE BAR -FIRE"
890 PRINT"  '●'-IS YOUR SHIPHELP ARRIVES IN 90SECONDS"
900 PRINT"      HIT ANY KEY"
910 GETA$:IFA$=""THEN910
920 POKE36879,8:GOTO3
```



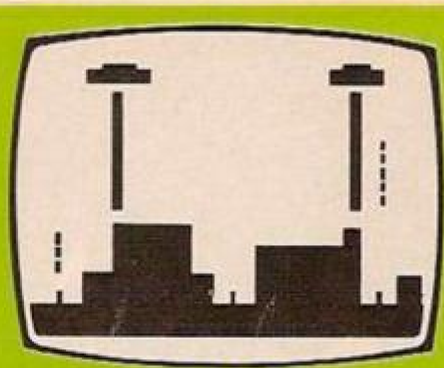
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This is a computer version of the popular "one armed bandit", with three reels, Nudge reel, and Hold, Nudge and Gamble functions. Incorporating the VIC's normal graphics, colour and sound, it requires an expanded VIC (3/8/16K).



2. BRICKDOWN:

A variation on the game "BREAKOUT"; using the keyboard or a joystick controller manoeuver the bat to try to break through the right hand wall, while protecting the left wall. Requires basic or 8K VIC.



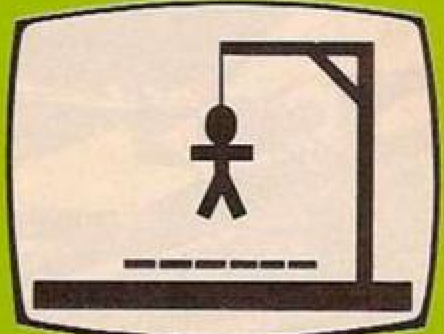
3. BLOCKADE:

Using joystick or keyboard, control your missile base to destroy incoming enemy missiles and protect your fuel dumps. Game ends when you are hit or all fuel dumps destroyed. Uses defined graphics, colour + sound. Runs in basic VIC only.



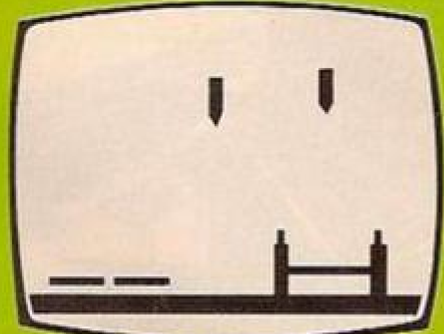
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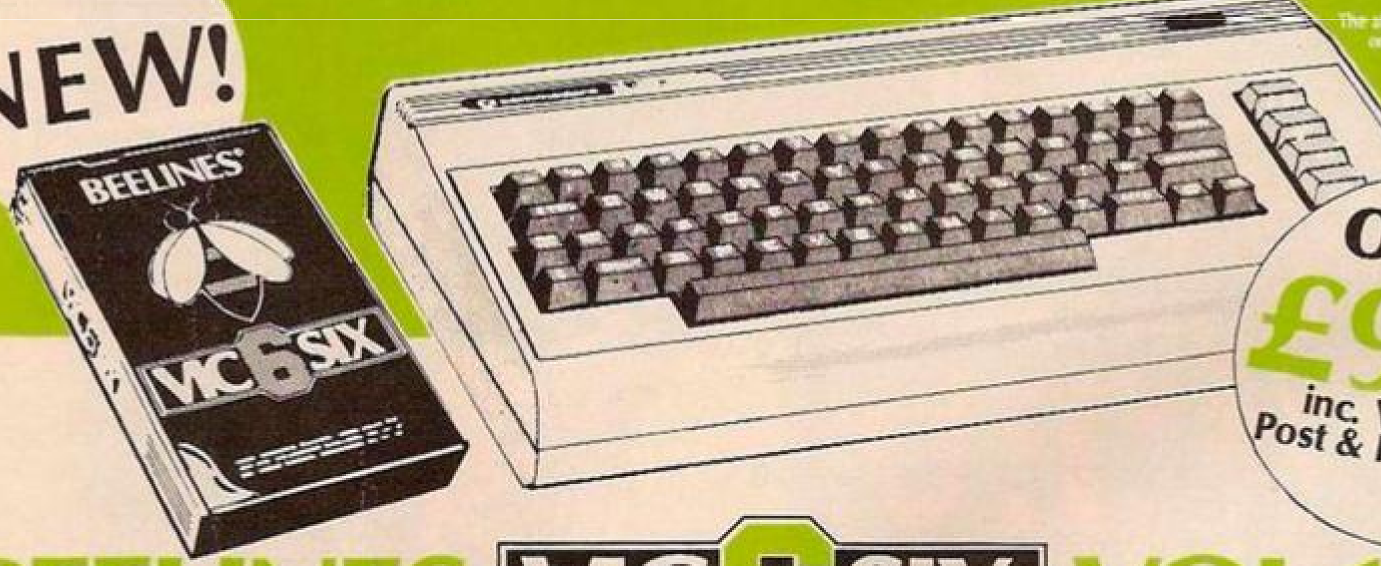


6. TARKUS:

With the joystick or keyboard, control the stretcher bearers to pick up the wounded men, and return them safely to the red cross base. If you are hit by an enemy missile, however, you join the wounded, on the field! Challenging and addictive, with defined graphics, colour + sound. Runs in basic VIC only.

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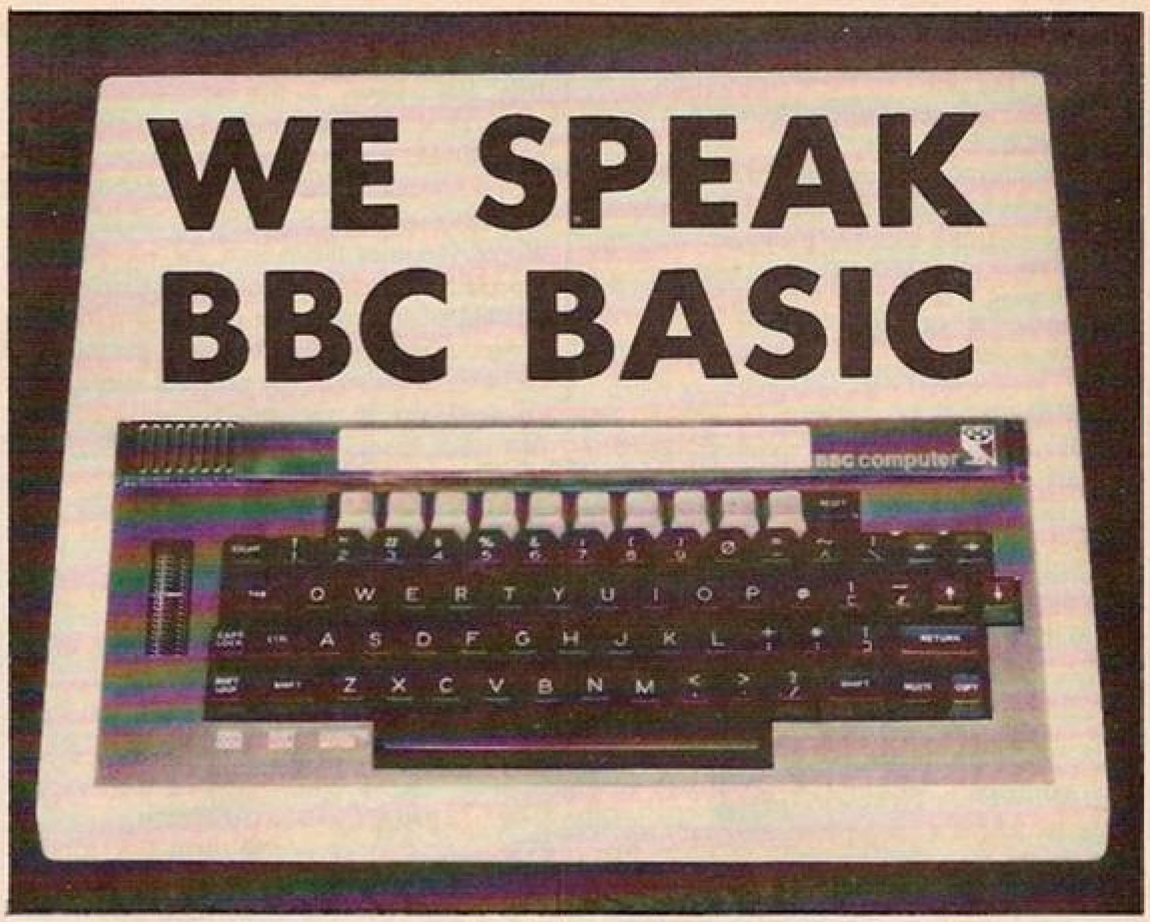
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WE SPEAK BBC BASIC



If you need to translate BBC Basic into other Basics or are just interested in the development of computer language Tony Edwards' introduction to translation and portability will be invaluable. Although Basic dialects appear so different that they might be separate languages in their own right they share many of the same concepts.

THE BBC COMPUTER, and hence its language, has its origins in the Proton, the Acorn machine which reached the prototype stage but was never produced commercially. The BBC Micro's language is, however, closer to Microsoft Basic than is that of its ancestor the Acorn Atom, and should cause little difficulty in translation.

The commands, statements and functions acceptable to the BBC interpreter are split into two groups: the common-core and the extensions. The idea is that the extensions should not be used if a program is to be transportable: the common core should be close to other Basics and most interpreters should swallow it without too much indigestion. On first sight, however, the extensions seem alien to users of other Basics and contain such additional statements as Repeat-Until and Local.

The range of statements found in the common-core subset of the language should cause few problems in translation to other Basics as they are all reasonably familiar. There are, however, some pitfalls. Not least among them are variable names. BBC Basic allows unlimited length of variable names and all characters are significant. Thus the line

```
10 IF INCOME < INFLOW THEN GOTO 100
   ELSE PRINT WARNINGS
```

may look acceptable, but if your Basic evaluates only the first two letters of a variable name you may be in trouble. Another problem with variable names is that BBC Basic accepts reserved words if they are lower case or embedded in another variable name. Hence the variable Poor may suit the BBC interpreter, but yours may not like it if Or is a reserved word.

Punctuation can also cause trouble so you should be on your guard. The well used and almost universal question mark as an abbreviation for Print does not appear in BBC Basic. Instead ?16000 returns the contents of address 16000 as would Peek(16000) and ?16000=10 puts 10 into address 16000 — that is, it serves as a Poke16000,10. This should not surprise Atom users, but those who use other machines may be disconcerted. Also left over from Atom Basic is " ' ", but in BBC Basic it is no longer a Rem, but a carriage return. Thus

```
PRINT"USE","THE","NEXT" ' "LINE
```

returns:

```
USE THE NEXT
LINE
```

The remainder of the common-core should be familiar to most Basic programmers and if some of the functions it contains do not work like those in your Basic, you should be able to mimic them with little difficulty.

The statement ASC(A$) returns the ASCII character value of the first character of A$, which should not surprise any one. If, however, A$ is a null string, it returns the value −1 which may not be so obvious. Inkey/Inkey$ and Get/Get$ are similar functions which read the next character from the keyboard. With the $, they expect a string — without it a common variable. Most Basics do not have a Get or Inkey but this can easily be mimicked using Val. For example, in the place of

```
10 N=GET
```

we would use

```
10 N$=INKEY$ : N=VAL(N$)
```

Inkey is different from Get in that the former waits a set time only for input — 10 ms for each figure after the function. This, too, is easily mimicked. The line

```
10 N=INKEY(100)
```

can be translated as:

```
 0 B$=INKEY$
10 FOR I=0 to 1000
20 A$=INKEY$
30 IF A$=""THEN 50
40 A=VAL(A$):I=1001
50 NEXT : IF A=0 THEN A= -1
```

This routine scans the keyboard for a fixed period — you must adjust the length of the loop to suit your processor — and returns the value of any numerical key pressed in that time. If no key is pressed, it returns the value −1. The line 0 may be necessary to alter the buffer of keys pressed before the loop starts.

If you are trying to mimic Inkey$ you will not need the Val function in line 40 nor the If-Then in line 50. There is a better way of doing this with a Repeat-Until loop but more of that later.

The BBC Basic's Restore statement is standard, but an additional feature is the facility to restore partly with Restore (line number). This is not possible in most other Basics and is a very useful facility. Unfortunately it is difficult to imitate.

A direct answer is to adjust the Data pointer. As a program is run the address of the next Data line is held in protected RAM. The Restore statement alters this so if you do not have a partial Restore facility you must alter this yourself with Poke statements. You should first find from your instruction books or other sources where this address is stored and then Poke a suitable new value into it.

For instance, on the Genie or TRS-80 the most significant byte is in memory address 16640 and the least significant one is in 16639. Thus a partial restore statement on these machines is

```
10 POKE16639,10 : POKE16640,200
```

To find out what values to Poke, Run your program with

```
?PEEK(16639) : ?PEEK(16640)
```

in front of the Read statement which first reads the line to which you wish to Restore. This will then print out two values close to those you need — close because any changes to the program in lines with lower numbers than the Data statements, including deleting the temporary Peeks, will change the address of the target Data line. You will have to change the Poked values until the program runs as you wish, remembering which address holds the most significant byte.

This is the most elegant solution once it is working. If, however, you think it too complex you could start your program by Reading all Data values into an array. Then call the various values as the contents of array elements as and when you need them, thus avoiding Restore altogether. This method uses a good deal of memory and causes the program run to pause while the Data is placed in the array.

There are a number of complex statements in BBC Basic such as

```
FOR N=1 TO VAL(A$)
```

or If-Then-Else which should be understandable even if your Basic does not have them. You must split them into smaller steps for your Basic. In the case of If-Then-Else you

(continued on next page)

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will have to use a complex net of Gotos. As an example, the line

```
10 IF A$="."THEN END ELSE IF A$=""THEN
   A$="0" ELSE A$="X"
```

is probably comprehensible to you even if your machine cannot understand it. Explain it to your machine with the program:

```
10 IF A$="." GOTO 100
20 IF A$="" GOTO 40
30 A$ = "X" GOTO 50
40 A$ = "0"
50 . . .
100 END
```

BBC Basic includes user-defined functions as part of the common-core. Those without this facility will have to use subroutines instead. To see how to do this consider the following program in BBC Basic.

```
10 DEF FNSECANT(A,R) =
   1/(COS(A+R*PI/2)
.
.
.
.
100 ANSWER = FNSECANT(200,Z)
```

Line 10 defines a function called Secant which returns the secant of the angle A plus R right angles, and line 100 uses this function to assign the result of this function to Answer when the angle is 200 plus Z right angles. Note the use of Pi as a dedicated constant equal to π. This is simulated in other Basics with:

```
10 B = 1/COS(A+R*3.14159/") : RETURN
.
.
.
.
100 A = 200 : R=Z : GOSUB 10
110 ANSWER = B
```

In this program the subroutine in line 10 has fixed the variables A and R. Before the Gosub the required values are assigned to these variables for use in the subroutine. On return from the subroutine, the result in variable B is assigned to the required variable Answer.

The BBC Basic extensions have been added to standard Basic in an attempt to improve it. These extensions are extra facilities which cannot be translated directly into other dialects. However, if we understand what they do, it is possible to simulate them in our own dialect.

The Repeat-Until loop is probably the most useful of these extensions. It allows a loop to be repeated a number of times until some pre-determined condition occurs which terminates it. It is permissible to leave the loop with a Goto and re-enter it later, and a single Repeat can serve as multiple Untils.

When faced with such a function to translate we must use some type of For-Next loop. This is, however, full of dangers. Consider this sub-program using Newton's Theorum of Successive Approximations to solve an algebraic equation:

```
10 REPEAT
20      Y1 = A*X^P + B*X
30      X1 = X - (Y1-Y)/(P*A*X^(p-1) + B)
40      X3 = X : X = X1
50 UNTIL ABS (X-X3)<0.001
```

This sub-program makes repeated estimations of the root of the equation $ax^p + bx = y$ for given values of a,b,p,x and y. The root is returned as X3.

When successive estimates differ by less than 0.001, the program continues. Note that BBC Basic uses ^ as the exponentation operator where you may use **,↑, or [. When the programmer writes this section of the program he has no idea how many times the loop would be implemented. This depends on the values of the variables taken into the sub-program, especially the accuracy of X the first approximation of the root. We can assume that the programmer has no control over the values of these variables when the program is run. How do we do this in a less sophisticated Basic? A first effort would be:

```
10 FOR I  = 1 TO 100
20      Y1 = A*X[P + B*X
30      X1 = X - (Y1-Y)/(P*A*X[(P-1) + B)
40      X3 = X : X = X1
50      IF ABS (X-X3)<0.001 THEN 70
60 NEXT I
```

That looks relatively easy, but in line 50 the program jumps out of a For-Next loop without reaching the next. Will your Basic allow this? If it does, how many times can you do it in one Run? The problem is that the machine, not having encountered a Next, thinks it is still within the loop so at the next occurrence of For it starts a new loop nested within the first — the result is often disastrous.

BBC Basic	Equivalents
X = ASN(A)	X = ATN(A/SQR(1-A*A))
X = ACS(A)	X = ATN(SQR(1-A*A)/A)
X = DEG(A)	X = A*57.2958
X = RAD(A)	X = A/57.2958
X = EXP(A)	X = 2.71828 ↑ A

Note that "↑" means "to the power of"

Table 1.

A further programming error is in line 10. Why put 100 as the upper limit of the loop? Why not 1000 or 10? If you reach the upper limit before ABS(X-X3)<0.001, the program leaves the loop with an inaccurate root in X3. The answer is to use the biggest number possible, but what is the largest limit your Basic will accept, and what is the maximum number of loops you will ever need?

Consider the program:

```
10 FOR   I = 0 TO 0 STEP 0
20      Y1 = A*X[P + B*X
30      X1 = X - (Y1-Y)/(P*A*X[(P-1) + B)
40      X3 = X : X = X1
50       I = NOT (ABS (X-X3)<0.001)
60 NEXT
```

This works but is not clear just what it does. This, in my view, spoils one of the best points of Basic. Nevertheless, at times we must write opaque programs when it is expedient.

When we work through this program to see what it does, it becomes apparent that line 10 does very little. It assigns 0 to the variable I, incrementing it by 0 each cycle of the loop until it is less than 0. That seems like a dead loop. Lines 20 to 40 are the sub-program as before. In line 50, I is set to some non-zero value if the escape criterion is reached, so line 60 will terminate the loop.

If the program will not run on your machine some small adjustments will be necessary. If line 50 is not acceptable to your compiler, replace it with a more direct test:

```
50 IF ABS(X-X3)<0.001 THEN I = -1
```

If your Basic does not leave the loop, test to see if your compiler thinks 0 is positive or negative — mine thinks it is negative. So, with a step of 0, it looks for a value less than the limit to escape. You may have to assign a positive number to I to escape.

If you use a ZX unit, the Repeat-Until loop is easily simulated as follows:

```
10 (start of loop)
12      .
14      .
16      .
18 GOTO (Condition)*10 + 10
```

On running, if the condition is false the jump is to 0 × 10 + 10 = 10. If the condition is true, the jump is to 1 * 10 + 10 = 20.

You now not only have a translation for the BBC Basic's Repeat-Until loop, but also an efficient extra function to use in your own programming. One word of warning: if the escape criterion is not reached for some reason, line 10 will loop forever. The Repeat-Until loop also has this problem so unless you are looking for a program with infinite running time, I suggest it would be good programming to add a loop counter which aborts the loop with a suitable error message after a reasonable time.

Armed with this new function you may like to refer it back and find a better way to mimic the Inkey function.

There are a number of useful trigonometrical functions in the extensions which are not usually found in other Basics. They can be mimicked directly using existing Basic functions. Table 1 shows a selection of these.

A more exotic addition is the Defproc-Endproc statement. The first statement will be followed by a number of parameters in brackets. You will have to assign a separate subroutine to handle the operation of the procedure and ensure that the variables used in your subroutine are assigned the correct values prior to the Gosub. Here the BBC Basic code will help you as the variables to be used in the procedure are those in brackets after the Defproc statement.

A word of warning: BBC Basic allows the local use of variables within procedures and functions. Where you see the statement Local, the variables that follow it will be treated as different from earlier variables having the same name. You should react to this by placing a marker in front of the local variables — that is, by calling the program variable XX %XX. Alternatively, if you do not use double-letter variables in your programming, double the first letter when local values are used so that the variable Time becomes TTtime. If you do this remember your compiler may not differentiate between TTime and TTop.

As a final warning this month I draw your attention to the BBC Basic function Div. The BBC computer has full floating-point arithmetic, but it also supports this integer division function. It is used regularly in programming, especially in games. If your computer does not have floating-point arithmetic all is well as it already believes that 5 ÷ 2 = 2. If, however, you do have this facility, remember that 5Div2 does not equal 2.5, so you must substitute A = B DIV C with A = INT(B/C) or A% = B/C if you can use % as an integer marker.

Next month we shall look at graphics — the major problem in the translation of programs from one Basic to another. ■

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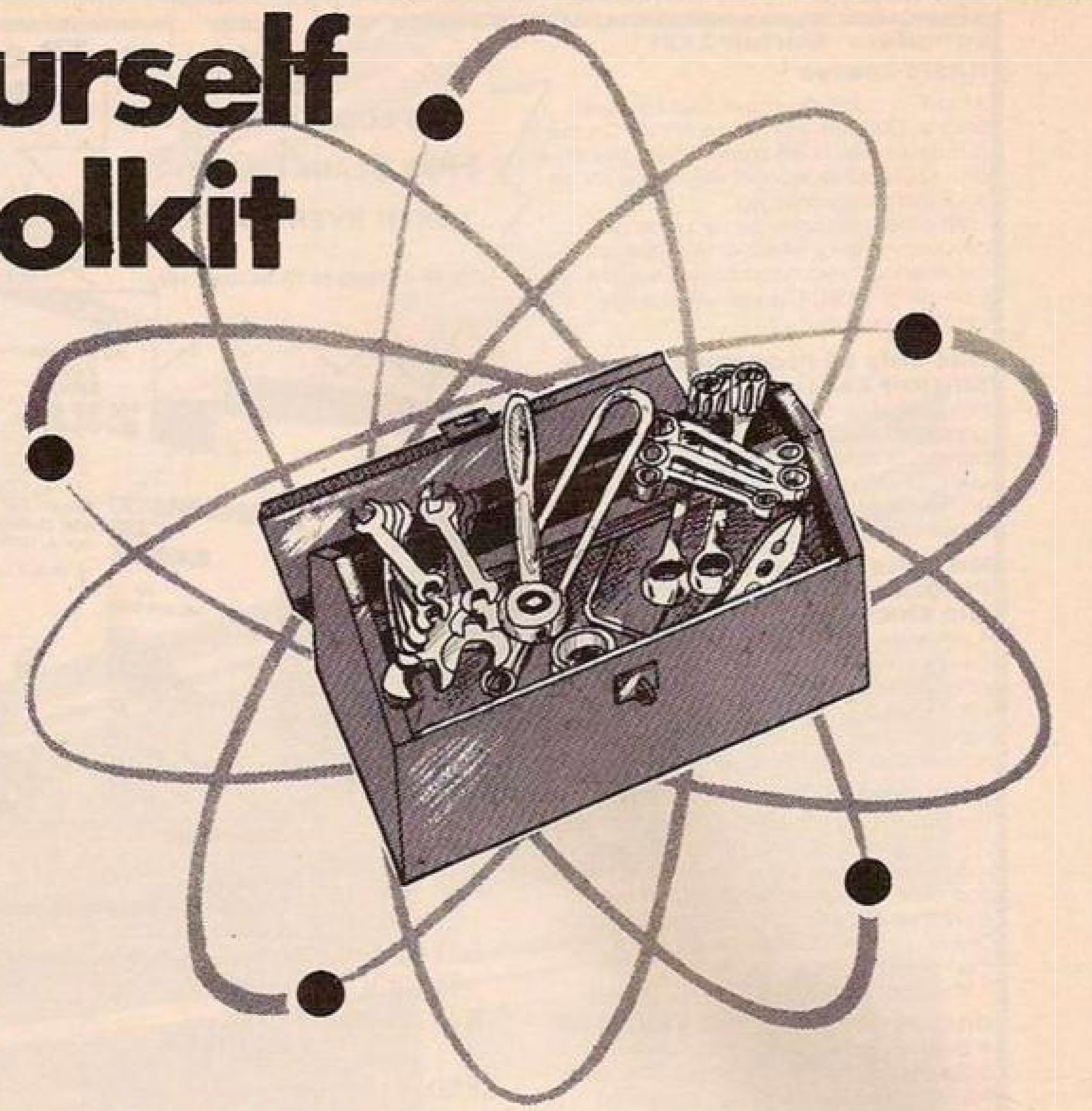
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Do-it-yourself Atom toolkit



David Berry shows how to implement a toolkit of mainframe utility routines on an Atom.

UTILITIES ARE routines which operate on programs, either to modify them or to assist in their construction. The microcomputer fraternity often refer to them as toolkits, and the word "tool" is a very apt description. Like all tools, a utility should be easy to use and unobtrusive — a natural, unfussy, and above all useful device, which can be picked up, used and put aside again easily and quickly.

The utilities I shall describe all occupy little-used areas of Atom RAM, they auto-run, and return control after use to the base address of the program being modified. Most make use of sound output to indicate the stage of processing the machine has reached, and employ machine-code routines for maximum speed.

Programs are stored on the Atom in a very simple text format. Each program line is bounded by carriage returns which have the ASCII code 13 or 0D hexademical. The Atom always assumes that the first two memory locations after a # 0D contain the high and low bytes of a program line number. The whole program is always terminated with the hexadecimal number FF, which appears in the location immediately after the last # 0D carriage return.

Saving bytes

You may have realised by now that the first byte of any given program must therefore be # 0D, and the last byte, at TOP-1, # FF. You can check this, next time you switch your machine on, by Peeking # 2900 and # 2901, where you will find # 0D and # FF respectively. Now type a line number, try 000255, followed by a return, print &Top and you will find that you have used only three bytes — not the seven you may have expected.

This explains why you cannot used these utilities on programs containing the line number 255. The decimal 255 is FF in hexadecimal, and while the Atom is clever enough not to be fooled at finding the program terminator in a line-number position, the memory-moving routines in these utilities are not. So, if line 255 is present, the utility will terminate prematurely. The same applies to any line number which puts FF into the second location after a # 0D, i.e., the decimal equivalents of # 1FF, # 2FF, # 3FF, and so on.

The machine-code routines for auto-running and memory-moving usually sit directly on top of the Basic text. This means that when you copy the programs you must put spaces only where I put them, and check that you obtain the same value for Top as those quoted.

I made a major assumption when I started writing Auto: that given a set of 26 labels, no-one would ever use line numbers as targets in Goto, Gosub and similar commands, and so this program totally ignores them.

Every time the program is run it renumbers the program at which it is pointed. Secondly, once renumbering is complete, or if the text area is empty, it automatically generates line numbers.

Auto is designed to live in the lower text space between # 2800 and # 2900 — # 2900 is where Basic programs normally start.

Program 1 gives the Auto listing, the value of Top you should strive for, and the *Save addresses. Before you type in the program remember to enter ?18= # 28 first or you will end up in the wrong RAM.

Address prompt

When you run the program it will prompt for the most-significant byte of the address of the first byte of the program to be renumbered or entered. This will most often be # 29 — do not forget the # . To terminate the run enter a return against the last line number generated.

The next two utilities need to be able to move large amounts of memory quickly. By that I mean that the contents of the memory has to be moved from one location to another. This is achieved by a machine-code routine which, in its assembler source-code form, is shown in program 5.

Program description

Line 10: Initialise the program and input the target program address.

Line 20: A points at memory locations occupied by the target program. If the second location contains the program terminator, # FF, the renumber routine is skipped.

Line 30: Subroutine b increases the line number count by 10, Pokes the new line number into its two locations, prints it and moves pointer A past it. Subroutine c moves the pointer past the string — program line — following the line number. The sequence is repeated until the program terminator is found.

Line 40: Start of generation of new line numbers. The number is printed by subroutine b as before, but now a program line is input and stored.

Line 50: If the string is empty, move A back two locations, Poke the program terminator into that address, reset the pointer in location 18 and terminate.

Line 60: Continue the endless loop a.

Program 1. Auto.

```
Ready machine

?18=#28
NEW

Enter program
10B=0;P.$12;IN."MSB"A;C=A;@=32
20A=A*#100;A=A+1;IF?A=#FF;G.a
30DOGOS.b;GOS.c;U.?A=#FF
40a@=0;GOSb;IN.$A
50IF?A=#D;A=A-2;?A=#FF;?18=C;E.
60GOS.c;G.a
70bB=B+10;?A=B/#100;A?1=B;P.B;A=A+2;R.
80cA=A+LENA+1;R.

Check value of Top equals #28CF
Enter auto run routine
P=#28CF;[;LDA@#28;STA18;STA6;LDA@0;STA5;JMP#C2F2;]

Save Program
*SAVE"AUTO"2800 2900 28CF
```

Memove itself is not a utility, but is simply a means to an end and all it does is roughly the equivalent of:

DO ?M = M?1; M = M + 1; U.?M = # FF

It just does it very, very quickly.

It is useful to enter Memove into the graphics RAM starting at # 8200, where it is clear of both the utilities and any test programs you may later enter at # 2900. So, type ?18 = # 82 and enter the program. For this you can put spaces and lines anywhere you like, with one exception: line 30 must not be altered or added to.

For the adventurous

The more adventurous among you will have tried using Auto to enter this program and, even now, may be tearing out handfuls of hair. In the interest of good will, to all readers: enter:

!# 8200 = # FF0D

and try again.

Dele is short for "delete", which is exactly what this routine does — it deletes blocks of lines from the target program. It is also intended to fit between # 2800 and # 2900, so Poke # 28 into location 18 before you start typing. Enter the program exactly as it appears in program 2 and check that your value for Top is the same as the quoted one. Now enter the auto-run routine as a direct command — that is, with no line number. This assembles the auto-run routine immediately on top of the Basic text. Next, assuming Memove is still at # 8200, follow the sequence of commands given which will change line 30 of Memove causing it to be assembled into memory starting at address # 28D8 — just above the auto-run routine. *Save Dele using the addresses given.

When you use Dele, you will be asked for the most-significant byte of the target program, and a start line number, SL =, and end line number, EL =. Both start and end lines are deleted together with all the lines between them.

Squash is a compactor. It removes all the spaces from the target program. Then, at the user's option, removes all Rem statements also. It is worth emphasising that it removes all spaces. In some cases spaces are required for the correct interpretation of Atom Basic statements, and you should check chapter 10 of the manual if you find that your program refuses to run properly after all the spaces have been removed.

It is, however, clever in its handling of Rem statements and can deal correctly with all variations. Rems may be preceded by a line number, label or semicolon. All of these possibilities are catered for.

Like Dele, Squash has to move large amounts of memory to fill the gaps left by the spaces and Rems it removes. To do this it uses Memove and, since Squash and the machine-code version of Memove add up to about 0.5K, it is too large for the usual RAM area between # 2800 and # 2900. Since I rarely use graphics mode 4, I decided that Squash could best be entered from address # 9600 — that is the top 0.5K of upper text space — and the information given in program 3 is based on that decision.

You can, of course, put it anywhere you like. For example, you may be happier to use the top 0.5K of lower text space. If so, replace # 96 and # 97, wherever they appear in the frame, with # 3A and # 3B respectively.

Follow the sequence in program 3 and you will enter the program, assemble the auto-run routine and, provided Memove is still at # 8200 — if it is not, load it now — assemble it on top of the rest of the code. Do not forget that your value of Top must equal the quoted one or you will overwrite the end of the Basic text.

When you run Squash it will prompt you for the most-significant byte of the target program start address. Then it will remove all the spaces in that program and, if the shift key is being held down when the bell rings, will continue on to remove the Rems too.

Edit is unusual — it modifies itself as it is running. It is a technique which will be useful in a number of situations such as computed Gotos using labels, or subroutine parameter passing.

One of the useful things about interpreters is that line number N + 1 is not read until line number N is finished with. This allows line N to modify line N + 1, and this is the concept used twice in Edit. In the first instance, line 40 changes the question marks in line 60 to exclamation marks in order to speed up the matching of long strings. Then, line 130 changes the From/To loop parameters in line 140.

Edit provides a facility for the global replacement of strings. That is, it takes a string entered from the keyboard and replaces every identical string in the target program with a second string entered at the same time. For example: it can replace every Print with P.; every In. with Input and so on.

You can also delete every occurrence of any particular string simply by entering a null replacement string — that is, just a return. But be careful, you must make your search string long enough to be specific to the string you want replaced.

If you want to replace variable name E with B and use as your search string only the letter E, the program will replace every letter E in the text. Next will become Nbxt, Let will become Lbt, "Enter E" will change to "Bntbr B", and so on.

Again this routine is too large to live at # 2800 and it, too, was entered at # 9600, but you can change this to suit yourself. The whole process for entering and saving Edit is shown in program 4.

Because Edit modifies itself by Poking characters into its own program line, extra care is necessary, when you enter the program, to copy the listing exactly. Every character and space must be in the correct position or the program may not run.

Speed comparison

When you run Edit you will be prompted for the usual most-significant byte and for two strings: $S = for the search string — the one to be replaced; and $R = for its replacement. This program does not use a machine-code routine for moving the memory contents and is thus much slower than the last two utilities. It may interest you to compare the speed of removing spaces with Edit and Squash. By my watch, Edit is no less than 40 times slower than Squash.

To run any of the utilities, all you have to do is mount the right tape and type

*RUN"name"

and the chosen routine will load and run automatically. When it has finished control is returned to the address given by

MSB * # 100

Program description

- Line 10: Input most-significant byte, calculate the first memory location of the target program and input the start and end line numbers.
- Line 20: Find the start of a program line, subroutine b sets Q equal to the next line number which is then checked against the start line number S.
- Line 30: Link to Memove until ?M becomes equal to # D, use subroutine b to find out whether the end line number has been exceeded — if not: repeat.
- Line 40: Terminate the run.

Program 2. Dele.

```
Ready machine
?18=#28
NEW

Enter program
10 IN."MSB"M;N=M;M=M*#100;M=M-1;IN."SL="S;IN."EL="E
20aDO M=M+1;U.?M=#D;GOS.b;IFQ<S;G.a
30cDO !#80=M;LI.#28D8;U.?M=#D;GOS.b;IF Q<=E G.c
40 ?18=N;E.
50bQ=M?1*#100+M?2;R.

        Check value of Top equals #28AC
Enter auto-run routine
P=#28AC;C:LDA@#28;STA18;STA6;LDA@0;STA5;JMP#C2F2;]

Change 'Memove' line 30 and run.

?18=#82
OLD
30 P=#28D8
RUN

Save program
*SAVE"DELE"2800 2900 28AC
```

Program 3. Squash.

Program description

- Line 10: Input most-significant byte and calculate the first memory location of the target program. Subroutine a jumps the pointer over text enclosed in quotation marks and line numbers, and searches for the program terminator.

(continued on next page)

```
Ready machine
?18=#96
NEW

Enter program
10IN."MSB"M;R=M;M=M*256;DOGOS.a
20IF?M=#20;!#80=M;LI.#97D0;M=M-1
30M=M+1;U.E;P.$7
```

(listing continued on next page)

(continued from previous page)

Line 20: If M points to a space, link to Memove to remove it.
Line 30: Continue the Do loop until E is true.
Line 40: If the shift key is not pressed: terminate.
Line 50: Reset pointer M to start.
Line 60: Start of loop b, Gosub a then check E to see whether the program end has been reached.
Line 70: If M is not pointing at a Rem statement, increment it. The FF in the ! command masks out the character following Rem.
Line 80: If a Rem is found, run along it until the statement terminator — either ; or # 0D — is found. S then contains the number of characters in the statement.
Line 90: If this Rem starts with a line number and ends with a # D, adjust M and S so that the line number is removed also.
Line 100: If this REM starts with a ; and ends with a # D, adjust M and S so that ; is removed.
Line 110: If this Rem starts with a label and ends with # D, M and S are adjusted so that line number and label are preserved.
Line 120: In all other cases, increment S to include the line terminator.
Line 130: Remove all characters in this line by linking to Memove.
Line 140: Subroutine e.

(listing continued from previous page)

```
40IF?#B001=#FF;?18=R;E.
50M=R*256
60bGOS.a;IF E;?18=R;E.
70IF!M&#FF000000<>#FF4D4552;M=M+1;G.b
80S=0;DOS=S+1;U.M?S=#3BORM?S=#D
90IFM?-3=#DIFM?S=#DM=M-3;S=S+3;G.c
100IFM?-1=#3BIFM?S=#DM=M-1;S=S+1;G.c
110IFM?-1>#60IFM?-1<#7BIFM?S=#D;G.c
120S=S+1
130cF.Q=ITOS;!#80=M;LI.#97D0;N.;G.b
140aE=0
150IF?M=#22;DOM=M+1;U.?M=#22
160IF?M=#DM=M+3
170IFM?1=#FF E=1;R.
180R.


Check value of Top equals #97B2
Enter auto-run routine
P=#97B2;[;LDA@#96;STA18;STA6;LDA@0;STA5;JMP#C2F2;]
Change 'Memove' line 30 and run
?18=#82
OLD
30 P=97D0
RUN
Save program
*SAVE"SQUASH"9600 9800 97B2
```

Program 4. Edit.

Program description

Line 10: Input and store the search and replacement strings.
Line 20: Check that the strings do not overflow into the Basic work area.
Line 30: Input the most-significant byte and calculate the first byte address of the target program.
Line 40: Change the ? in line 60 to ! if the search string is longer than three characters.
Line 50: Start searching the target program; jump over line numbers.
Line 60: If the first, or first four, characters of the search string match those being examined, Gosub c; reset the start of the search and replacement strings on return from c.
Line 70: Repeat until the program end is reached, reset location 18.
Subroutine c:
Line 80: Return if there is a mismatch between the search string character and the one being examined.
Line 90: Move along one character; if this is not the end of the search string, go back to line 80.
Line 100: Subroutine e generates a noise; the rest of this line finds the program-end location.
Line 110: Is the search string longer, as long, or shorter than the replacement string? D holds the difference in lengths.
Line 120: If D is positive, K becomes +1; if D is negative, K becomes -1.
Line 130: Change line 140 to read O to M or M to O depending on the value of K.
Line 140: Move the memory contents forward or backwards by D bytes to eliminate or make room for the difference in string lengths.
Line 150: Move the memory pointer backwards to the start of the string. If the replacement string is null, miss the next line.
Line 160: Insert the replacement string into memory.
Line 170: Go back one byte then return.

```
Ready machine
?18=#96
NEW
Enter program
10aP.$12;S=#21C;IN."$S=";T=LENS;R=S+T+1;IN."$R=";P=LENR
20IFR+P+1>#23F G.a
30IN."MSB"M;Q=M;M=M*#100
40!#96B5=#3F3D533F;IFT>3;!#96B5=#213D5321
50M=M+1;DOM=M+1;IF?M=#D M=M+3
60IF?S=?M GOS.c;S=#21C;R=S+T+1
70GOS.e;U.?M=#FF;P."END";?18=Q;E.
80cIF?M<>?S R.
90M=M+1;S=S+1;IF?S<>#D G.c
100O=M;DOGOS.e;O=O+1;U.?O=#FF
110D=P-T;IFD=0G.d
120K=((D&#ff)-#7f)/#80
130?#9782=#4E+K;?#9787=#4E-K
140F.L=N TO N S.-K;D?L=?L;GOS.e;N.
150dM=M-T;IFP=0G.f
160DO?M=?R;M=M+1;R=R+1;U.?R=#D
170fM=M-1;R.
180e?#B002=?#B002:4;R.
Check value of Top equals #97F1
Enter auto-run routine
P=#97F1; ;LDA@#96;STA18;STA6;LDA@0;STA5;JMP#C2F2;
Save program
*SAVE"EDIT"9600 9800 97F1
```

Program 5. Memove.

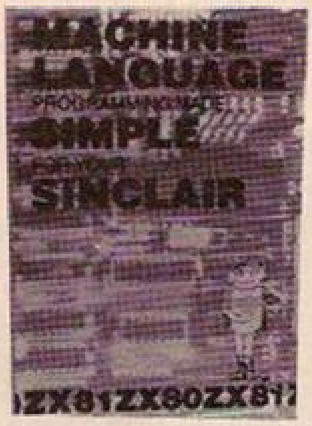
```
Ready machine
?18=#82
NEW

Enter program
10 DIM LL2
20 FOR Q=0 TO 1
30 P=#97D0
40[
50:LL0 LDY #80;LDA @0;STA #80;INY
60:LL1 LDA(#80),Y;DEY;STA(#80),Y;STA #B002
70 CMP @#FF;BEQ LL2;INY;INY;BNE LL1
80 INC #81;LDA(#80),Y;DEC #81;DEY
90 STA(#80),Y;INC #81;INY;INY
100 JMP LL1
110:LL2 RTS
120]
130 NEXT Q
140 END
Save the program
SAVE "MEMOVE"
```

■

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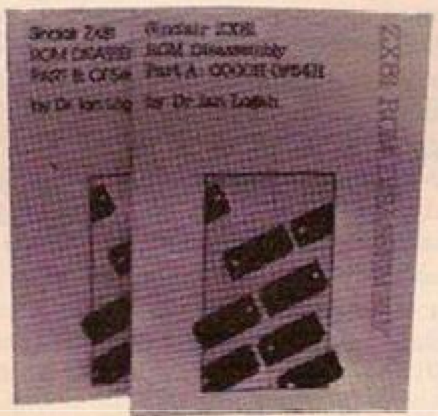
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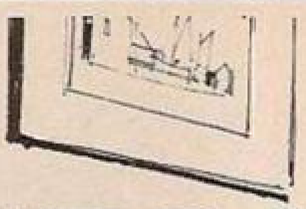
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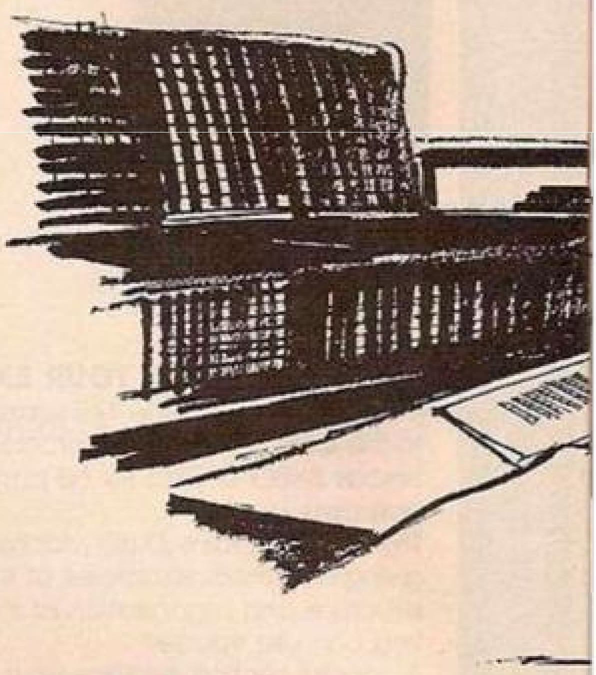
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MACHINE CODE



THE MISSING MONITOR



The ZX-81's monitor lacks the facilities to alter, search, set, save and display memory and copy the screen to printer without clearing it. John Sylvester's ZXMinbug, a machine-code monitor, remedies those shortcomings.

THIS PROGRAM provides the ZX-81 with a machine-code monitor. It is 609 bytes long, and resides in a Rem statement at the beginning of the Basic program. ZXMinbug offers the user what I consider to be the minimum number of functions necessary in a monitor, and is relatively simple to operate. The method of entering the necessary code into the Rem statement is left to you.

The first of the functions available is Alter Memory. It means that the contents of any RAM memory location can be inspected and modified as required. The monitor runs in this mode except when performing one of the required functions.

Search Memory performs a search for two specified bytes. If the search is successful, an automatic dump is made to the screen, starting at the location of the specified bytes.

Table 1.

0 to 9 and A to F are used for data entry
Newline is the field delimiter
H allows the user to set the parameters to execute a subroutine
K allows the user to set the parameters to initiate a search
L allows the user to set parameters to move or set a block of memory
P allows the user to set parameters to do a hex dump to screen
R resets the cursor to the start of the input line
S saves the memory on cassette
Z gives a return to Basic

A block of memory can be relocated anywhere in RAM with Move Memory, and Set Memory enables you to set a block of RAM to any value. The Save function ensures that data in memory can be saved on cassette for future loading.

Memory can be displayed on the screen in hexadecimal code with Display Memory. The display can be either static or dynamic. A static display is not updated should any of the locations dumped be changed. However, the dynamic display shows all changes as they occur.

The Copy function is really a return to Basic, but on return the screen is not cleared and so allows a copy of the screen to be output to the printer. The user, by specifying the start location, can execute a program and return from the program to monitor is by means of a Ret instruction. The keys used in the monitor are shown in table 1.

When run either manually or automatically, the display will clear and then present the location 0000 and the contents of that location on the first line. The cursor is shown as a reverse character.

Pressing Newline will move the cursor to the contents field. If you then press it again, the memory location will be incremented by one and the contents of the new location will be shown; the cursor remains in the contents field. If any changes are made to the contents, the new value will be stored in the location shown when Newline is pressed.

If R is pressed, the cursor is moved back to the location field and a new location can be typed. Note that all locations must be typed in full — for example, for location 0120, 0120 must be typed and not 120.

Pressing Newline now will display the contents of the selected location and the cursor will be in the contents field ready to modify the contents if required. When the R key is pressed, if the cursor is in the location field, any changes will be removed and the address will be set to its original location where it resided before any changes were made. If the cursor is in the contents field, the cursor is moved to the start of the location field and the original value for the address shown will be displayed — if, that is, any changes have been made.

When entering an address or contents, the cursor is moved to the start of that field when the last character is typed. No changes are made until Newline is pressed.

To operate the functions, press the required key. Pressing Z will immediately return control to Basic. Depending on how long you press Z, an error code will be shown or Copy will be displayed. The error code can be ignored.

Pressing S will start to save data on the cassette. If the Break key is pressed, the save will be aborted and Basic will be entered. To re-enter the monitor, just type Run and the monitor will carry on as it was, except that the location displayed on the input line will be set to 0000. If a screen dump had been active this will resume.

If you press H, which executes the program, the location 40AC will be displayed and the cursor will be in the contents field. Enter the least-significant byte of the address of your routine and press Newline; then enter the most-significant byte of the address and press Newline. The next location is the flag, so enter 01 and press Newline. The monitor has four flags and constantly checks them. As soon as it sees that the flag has been set, the routine will be executed. The flag is automatically reset.

If K is pressed for a search, the address 409E is displayed. Set as shown in table 2. The search will be carried out — it takes between three and four seconds to search 65,535 bytes. If the search is successful, an automatic dump is done regardless of whether a dump is active or not. If a dump is in progresss, the search dump will be dynamic. If a dump had not been active, the dump will not be dynamic. The flag is automatically reset when the search is done. No indication is given should the search fail.

P, which dumps memory to screen, will display location 409B. Enter the following:

409B: least-significant byte of the location at which dump is to start
409C: is the most-significant byte
409D: the flag, set to 01

The dump will take place. The flag in this instance is not reset and so the dump always remains active, not showing any change in memory until the user resets the flag. Pressing L, to move or set memory, displays location 40A5. Set as shown in table 3.

The L function can work in two ways: the first is to move a block of memory, and the second is to set a block of memory. In the first case, it is essential that the address to which data is to be moved does not fall inside the area covered by the start address together with that covered by the block size.

Table 2.

409E: least-significant byte of the address from which to start searching
409F: most-significant byte of address
40A0: least-significant byte of the amount to search
40A1: most-significant byte of the amount
40A2: enter the second byte to be searched for
40A3: enter the first byte to be searched for
40A4: is the flag, set to 01



Table 3.
40A5: least-significant byte of address from which data is to be taken
40A6: most-significant byte
40A7: least-significant byte of address to which data is to be stored
40A8: most-significant byte
40A9: least-significant byte of amount of data to be moved
40AA: most-significant byte of the amount of data to be moved
40AB: the flag, set to 01

In the second case, to set a block of memory, enter into the first location of the block the value to which the block is to be set. Enter the parameters given, but in location 40A7/8 set the address as that set in location 40A5/6, incremented by one. That is the address of the second location of the block. Set the amount to the size of the block decremented by one. An example is to clear — that is, to set to zero — the block of memory between locations 4700 hexadecimal to 4800 hexadecimal.

Location	Value	
4700	00	first location block to be set, is set to 00.
40A5	00 47	enter address of the start of block.
40A7	01 47	enter address of the second location of the block.
40A9	FF 00	enter the block size minus 1.
40AB	01	set flag.

The locations 4700 hexadecimal and 4800 hexadecimal will now be set to zero. The flag is reset automatically.

Locations 4084 hexadecimal and 4091 hexadecimal in the main program contain the addresses of the parameters for the various functions: 4097 hexadecimal to 409A hexadecimal hold the variables used by the monitor; 409B to 40AE are the parameters of the various functions; 40AF to 40B6 contain the table of control-key codes; 40B7 to 40C6 are the routine address tables and correspond to the control-key table; 40C7 to 40EF contain the routine to initialise the monitor. This sets up the input- and display-area addresses, displays the first location on screen and reads the keyboard for future keyboard testing.

40F0 to 4122 holds the main routine. This places a cursor on the screen then checks the keyboard for an input. If a key has been pressed, it then checks to see if the key is the same as the previous key; if so, it ignores it. If the key is different, the cursor is removed and the character is found and then checked to see if it is a data character or control character.

If the key is neither, it is ignored. If it is a data character it is then displayed and the cursor is placed in the next position. If it is a control character, execution is started at location 4141, and the address of the selected function is calculated from the ATable and KTable and control passed to that function.

4123 to 413F is the flag-check routine. This is used when an invalid character is entered, if no key is pressed or if the key pressed is the same as that pressed previously. Each flag is checked and if set the corresponding routine is executed, if no flags are set, execution is passed back to location 40F3.

The hexadecimal loader.

```
   1 REM ** HEX LOADER FOR ZXMIN
BUG
  10 PRINT ,,"ENTER EACH BYTE IN
 HEX THEN N/L"
  20 FOR X=16514 TO 17122
  25 FAST
  30 SCROLL
  40 LET X1=X-16384
  50 DIM H$(4)
  55 LET H$(1)="4"
  60 FOR P=2 TO 0 STEP -1
  70 LET X2=INT (X1/(16**P))
  80 LET H$(4-P)=CHR$ (X2+28)
  90 LET X1=X1-(X2*(16**P))
 100 NEXT P
 105 SLOW
 110 PRINT H$,
 120 INPUT A$
 130 LET H=(CODE A$(1)-28)*16+(C
ODE A$(2)-28)
 140 POKE X,H
 150 PRINT A$
 160 NEXT X
```

Program 1.

```
1 REM MACHINE CODE IS HELD IN THIS
  REM STATEMENT. THIS SHOULD BE
  COMPOSED OF 609 CHARACTERS
2 RAND USR 16583
3 GOTO 2
4 SAVE "ZXMINBUG"
5 GOTO 2
```

POKE 16510,0 (This gives the Rem line a line number of zero, to prevent accidental deletion).
RUN 4 (This saves the program and allows automatic run on loading).
Notes: line 3 is needed to prevent a Save function occurring when loading a program saved by the save function in ZXMinbug. To load a program saved by ZXMinbug enter LOAD"".

4165 to 414B contain the routine to display data on the screen; 417C to 4183 set or reset the cursor; 4184 to 41A3 are the hexadecimal to display code conversion routine; 41A4 to 41CE is the display code to hexadecimal conversion routine; and 41CF to 41F3 are the initialisation routines for the flag-operated functions.

The remaining locations are the actual function routines. The keyboard is read automatically by the ZX-81 during its display routine and the monitor keeps checking location 4025 to see if a key is pressed. If a key is kept pressed, then the code remains in that location. Therefore, to prevent the keyboard repeating, a check is necessary to see if the same character is present. If so, that character is ignored until a different one is sensed or it is set to FFFF, indicating that no key is pressed.

This means if the A key is pressed and kept pressed, only one A is accepted, but as soon as the key is released it will be sensed. This will set 4025 to FFFF, so the same key can be pressed again and it will register. If this was not done, the character would be printed on the screen so fast and so many times that it would be impossible to set any data up.

Should you write a program in an address greater than that specified in location 4014/5, it will not be saved. I therefore recommend that as usual, a Rem statement is created holding enough characters for your program. Having done this, run the monitor and search for the Rem code and the code of the first character used in the Rem statement.

It is advisable that the first two locations of the Rem statement be filled with 76 (Newline) to prevent a listing when back in the Basic mode. The reason is that should the Rem statement be listed, it may be bigger than the screen and the ZX-81 will keep trying to fit it on the screen. This results in the machine hanging up.

The program can only operate on a ZX-81 equipped with a memory larger than 3.5K. This is because it requires an expanded display file.

If your ZX-81 has the new ROM, then the addresses given in the listing as 40CA and 426D, contents CD 28 0E, should be amended to CD 2B 0F. Also address 4267, contents CD 20 0F, should be changed to CD 23 0F.

(continued on page 53)

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(continued from page 51)

LOCN	CODE	LABEL	MNEMONIC		REMARKS
4082	76		HALT		PREVENT LISTING
4083	76		HALT		
4084	9B 40	#DLOC	HEX	409B	ADDRESS OF DLOC
4086	9E 40	#SADD	HEX	409E	ADDRESS OF SADD
4088	A5 40	#MADD	HEX	40A5	ADDRESS OF MADD
408A	AC 40	#EXECL	HEX	40AC	ADDRESS OF EXECL
408C	AF 40	#KTABLE	HEX	40AF	ADDRESS OF KTABLE
408E	B7 40	#ATABLE	HEX	40B7	ADDRESS OF ATABLE
4090	F0 40	#CON	HEX	40F0	ADDRESS OF CURSORON
4092	00 00	LOCN	HEX	0000	ADDRESS TO WHICH INPUT IS BEING DONE
4094	00	VALUE	HEX	00	CONTENTS OF ADDRESS IN LOCN
4095	00 00	INPUT	HEX	0000	CURSOR POSITION
4097	00 00	DLINE	HEX	0000	START ADDRESS OF SCREEN DUMP AREA
4099	00 00	FSTART	HEX	0000	START ADDRESS OF INPUT FIELD
409B	00 00	DLOC	HEX	0000	FIRST ADDRESS TO DUMP ON SCREEN
409D	00	DFLAG	HEX	00	DUMP FLAG
409E	00 00	SADD	HEX	0000	START ADDRESS OF BLOCK TO SEARCH
40A0	00 00	AMTS	HEX	0000	LENGTH OF BLOCK TO SEARCH
40A2	00 00	WORD	HEX	0000	DATA TO SEARCH FOR
40A4	00	SFLAG	HEX	00	SEARCH FLAG
40A5	00 00	MADD	HEX	0000	START ADDRESS OF BLOCK TO MOVE DATA FROM
40A7	00 00	DADD	HEX	0000	START ADDRESS OF BLOCK TO MOVE DATA TO
40A9	00 00	AMT	HEX	0000	LENGTH OF BLOCK
40AB	00	MFLAG	HEX	00	MOVE FLAG
40AC	00 00	EXECL	HEX	0000	ADDRESS OF USER SUBROUTINE
40AE	00	EFLAG	HEX	00	EXECUTE FLAG
40AF	76	KTABLE	HEX	76	CONTROL KEY TABLE
40B0	35		HEX	35	
40B1	30		HEX	30	
40B2	31		HEX	31	
40B3	2D		HEX	2D	
40B4	38		HEX	38	
40B5	3F		HEX	3F	
40B6	37		HEX	37	
40B7	84 42	ATABLE	HEX	4284	CONTROL ROUTINE ADDRESS TABLE-FUNC
40B9	CF 41		HEX	41CF	DUMP
40BB	E6 41		HEX	41E6	SEARCH
40BD	EB 41		HEX	41EB	MOVE
40BF	F0 41		HEX	41F0	EXEC
40C1	67 42		HEX	4267	SAVE
40C3	D9 42		HEX	42D9	COPY
40C5	7D 42		HEX	427D	NLINE
40C7	CD 2A 0A	INIT	CALL	0A2A	CLEAR SCREEN
40CA	CD 2B 0F		CALL	0F2B	ENTER SLOW MODE
40CD	2A 0C 40		LD	HL,(DF-CC)	GET START OF DISPLAY FILE
40D0	22 95 40		LD	(INPUT),HL	SET CURSOR POSITION
40D3	22 99 40		LD	(FSTART),HL	SET START OF INPUT FIELD
40D6	01 42 00		LD	BC,0042	
40D9	09		ADD	HL,BC	
40DA	00		NOP		
40DB	22 97 40		LD	(DLINE),HL	SET START OF DISPLAY AREA
40DE	01 00 00		LD	BC,0	
40E1	ED 43 92 40		LD	(LOCN),BC	SET LOCATION TO DISPLAY
40E5	0A		LD	A,(BC)	GET CONTENTS OF LOCATION
40E6	32 94 40		LD	(VALUE),A	SET VALUE TO DISPLAY
40E9	CD 65 41		CALL	DLOCK	DISPLAY LOCATION AND CONTENTS ON SCREEN
40EC	2A 24 40		LD	HL,(LAST-K)	GET KEYBOARD CODE
40EF	E5		PUSH	HL	SAVE ON STACK
40F0	CD 7C 41	CURSORON	CALL	CURSOR	PUT CURSOR ON SCREEN
40F3	ED 4B 25 40	TKEY	LD	BC,(LAST-K)	GET NEW KEYBOARD CODE
40F7	E1		POP	HL	GET OLD KEYBOARD CODE
40F8	C5		PUSH	BC	SAVE NEW KEYBOARD CODE
40F9	B7		OR	A	CLEAR CARRY FLAG
40FA	ED 42		SBC	HL,BC	IS NEW CODE SAME AS OLD CODE
40FC	28 25		JR	Z,FLAGTST	YES - IGNORE AND GO TEST FLAGS
40FE	51		LD	D,C	TEST IF CODE IS FFFF
40FF	14		INC	D	
4100	28 21		JR	Z,FLAGTST	NO KEY PRESSED GO TEST FLAGS
4102	CD 7C 41		CALL	CURSOR	CLEAR CURSOR FROM SCREEN
4105	CD BD 07		CALL	07BD	GO GET CHAR. CODE ADDRESS
4108	7E		LD	A,(HL)	GET CHAR. CODE
4109	FE 1C		CP	1C	IS IT LESS THAN "0"
410B	38 34		JR	C,CONTROL	YES
410D	FE 2C		CP	2C	IS IT GREATER THAN "F"
410F	30 30		JR	NC,CONTROL	YES
4111	2A 95 40		LD	HL,(INPUT)	GET CURSOR POSITION
4114	77		LD	(HL),A	STORE CHARACTER ON SCREEN
4115	23		INC	HL	INCREMENT CURSOR POSITION
4116	7E		LD	A,(HL)	TEST FOR END OF FIELD
4117	FE 00		CP	0	
4119	20 03		JR	NZ,NWRAP	NOT END OF FIELD
411B	2A 99 40		LD	HL,(FSTART)	RESET TO START OF FIELD
411E	22 95 40	NWRAP	LD	(INPUT),HL	SAVE NEW CURSOR POSITION
4121	18 CD		JR	CURSORON	PUT CURSOR ON SCREEN
4123	3A 9D 40	FLAGTST	LD	A,(DFLAG)	GET DUMP FLAG
4126	B7		OR	A	CHECK PARITY
4127	E4 F5 41		CALL	PO,DUMPM	IF PARITY ODD CALL ROUTINE TO DUMP
412A	3A A4 40		LD	A,(SFLAG)	TEST SEARCH FLAG
412D	B7		OR	A	
412E	E4 17 42		CALL	PO,SEARCHS	
4131	3A AB 40		LD	A,(MFLAG)	TEST MOVE FLAG
4134	B7		OR	A	
4135	E4 45 42		CALL	PO,MOVES	
4138	3A AE 40		LD	A,(HL)	TEST EXEC FLAG
413B	B7		OR	A	
413C	E4 58 42		CALL	PO,EXECS	
413F	18 B2		JR	TKEY	GO CHECK KEYBOARD
4141	2A 8C 40	CONTROL	LD	HL(#KTABLE)	GET START OF KEY TABLE
4144	01 08 00		LD	BC,0008	
4147	ED B1		CPIR		SEARCH FOR KEY
4149	20 A5		JR	NZ,CURSORON	KEY NOT VALID
414B	ED 4B 8C 40		LD	BC,(#KTABLE)	CALCULATE POSITION OF ADDRESS
					IN ADDRESS TABLE
414F	B7		OR	A	CLEAR CARRY FLAG
4150	ED 42		SBC	HL,BC	
4152	ED 6A		ADD	HL,HL	
4154	ED 4B 8E 40		LD	BC,(#ATABLE)	
4158	09		ADD	HL,BC	
4159	2B		DEC	HL	
415A	2B		DEC	HL	
415B	5E		LD	E,(HL)	PUT ROUTINE ADDRESS IN DE
415C	23		INC	HL	
415D	56		LD	D,(HL)	
415E	EB		EX	DE,HL	PUT ADDRESS IN HL REGISTER
415F	ED 5B 90 40		LD	DE,(#CON)	GET RETURN ADDRESS
4163	D5		PUSH	DE	SAVE RETURN ADDRESS ON THE STACK
4164	E9		JP	(HL)	CALL ROUTINE
4165	2A 92 40	DLOCK	LD	HL,(LOCN)	GET ADDRESS TO DISPLAY
4168	7E		LD	A,(HL)	GET CONTENTS OF ADDRESS
4169	32 94 40		LD	(VALUE),A	SAVE CONTENTS
416C	ED 5B 0C 40		LD	DE,(DF-CC)	GET START OF INPUT LINE
4170	CD 84 41		CALL	ADDS	DISPLAY ADDRESS
4173	13		INC	DE	INCREMENT SCREEN ADDRESS
4174	3A 94 40		LD	A,(VALUE)	GET CONTENTS
4177	6F		LD	L,A	
4178	CD 8C 41		CALL	DATA	DISPLAY CONTENTS
417B	C9		RET		RETURN TO CALLER
417C	2A 95 40	CURSOR	LD	HL,(INPUT)	GET CURRENT POSITION
417F	7E		LD	A,(HL)	GET CONTENTS
4180	C6 80		ADD	A,80	SET/RESET BIT 7
4182	77		LD	(HL),A	PUT RESULT ON SCREEN
4183	C9		RET		RETURN TO CALLER
4184	7C	ADDS	LD	A,H	GET HIGH ORDER BYTE
4185	CD 95 41		CALL	MSD	ISOLATE MSD
4188	7C		LD	A,H	GET HIGH ORDER BYTE
4189	CD 91 41		CALL	LSD	ISOLATE LSD
418C	7D	DATA	LD	A,L	GET LOW ORDER BYTE
418D	CD 95 41		CALL	MSD	ISOLATE MSD
4190	7D		LD	A,L	GET LOW ORDER BYTE
4191	E6 0F	LSD	AND	0F	ISOLATE LSD
4193	18 0A		JR	DISP	PUT ON SCREEN
4195	E6 F0	MSD	AND	F0	ISOLATE MSD
4197	CB 3F		SRL	A	SHIFT REGISTER A RIHT 4 TIMES
4199	CB 3F		SRL	A	
419B	CB 3F		SRL	A	
419D	CB 3F		SRL	A	
419F	C6 1C	DISP	ADD	A,1C	CONVERT TO DISPLAY CODE

(continued on next page)

(continued from previous page)

```
41A1  12                    LD    (DE),A        STORE ON SCREEN
41A2  13                    INC   DE            INCREMENT SCREEN ADDRESS
41A3  C9                    RET                 RETURN TO CALLER
41A4  CD C1 41     ADDRX    CALL  LOAD          GET DISPLAY CODE
41A7  CD C4 41              CALL  MSDX          CONVERT TO HEX MSD
41AA  67                    LD    A,H           STORE MSD IN H
41AB  CD C1 41              CALL  LOAD          GET DISPLAY CODE
41AE  D6 1C                 SUB   1C            CONVERT TO HEX
41B0  84                    ADD   A,H           ADD MSD TO LSD
41B1  67                    LD    H,A           STORE RESULT IN H
41B2  CD C1 41     DATAX    CALL  LOAD          GET DISPLAY CODE
41B5  CD C4 41              CALL  MSDX          REPEAT FOR LOW ORDER BYTE
41B8  6F                    LD    L,A
41B9  CD C1 41              CALL  LOAD
41BC  D6 1C                 SUB   1C
41BE  85                    ADD   A,L           FORM LOW ORDER BYTE
41BF  6F                    LD    L,A           STORE IN L
41C0  C9                    RET                 RETURN TO CALLER
41C1  1A           LOAD     LD    A,(DE)        GET CHAR FROM SCREEN
41C2  13                    INC   DE            INCREMENT SCREEN POSITION
41C3  C9                    RET                 RETURN TO CALLER
41C4  D6 1C        MSDX     SUB   1C            CONVERT TO HEX
41C6  CB 27                 SLA   A             SHIFT REGISTER LEFT 4 TIMES
41C8  CB 27                 SLA   A
41CA  CB 27                 SLA   A
41CC  CB 27                 SLA   A
41CE  C9                    RET                 RETURN TO CALLER
41CF  2A 84 40     DUMP     LD    HL,(PDLOC)    GET ADDRESS OF DUMP PARAMETERS
41D2  22 92 40     SETLOC   LD    (LOCN),HL
41D5  CD 65 41              CALL  DLOCX         DISPLAY ON SCREEN
41D8  2A 0E 40              LD    HL,(DF-CC)    SET CURSOR AND INPUT POSITION TO START
                                                OF CONTENTS FIELD
41DB  01 05 00              LD    BC,5
41DE  09                    ADD   HL,BC
41DF  22 95 40              LD    (INPUT),HL
41E2  22 99 40              LD    (FSTART),HL
41E5  C9                    RET
41E6  2A 86 40     SEARCH   LD    HL,(PSADD)    GET ADDRESS OF SEARCH PARAMETER
41E9  18 E7                 JR    SETLOC
41EB  2A 88 40     MOVE     LD    HL,(PMADD)    GET ADDRESS OF MOVE PARAMETERS
41EE  18 E2                 JR    SETLOC
41F0  2A 8A 40     EXEC     LD    HL,(PEXECL)   GET ADDRESS OF EXEC PARAMETER
41F3  18 DD                 JR    SETLOC
41F5  2A 9B 40     DUMPH    LD    HL,(DLOC)     GET FIRST ADDRESS TO DUMP
41F8  ED 5B 97 40           LD    DE,(DLINE)    GET SCREEN POSITION
41FC  0E 14                 LD    C,14          SET LINE COUNT
41FE  CD A6 41     DUMPX    CALL  ADDS          DISPLAY FIRST ADDRESS OF LINE
4201  06 05                 LD    B,5           INC SCREEN BY 5 SPACES
4203  13           RIGHT    INC   DE
4204  10 FD                 DJNZ  RIGHT
4206  06 08                 LD    B,8           SET COLUMN COUNT
4208  7E           NBYTE    LD    A,(HL)        GET BYTE TO DISPLAY
4209  23                    INC   HL            INC MEMORY ADDRESS
420A  E5                    PUSH  HL            SAVE ADDRESS ON STACK
420B  6F                    LD    L,A
420C  CD 8C 41              CALL  DATA          GO PUT BYTE ON SCREEN
420F  13                    INC   DE            INC. SCREEN ADDRESS
4210  E1                    POP   HL            RETRIEVE MEMORY ADDRESS
4211  10 F5                 DJNZ  NBYTE         IF COLUMN COUNT IS NOT ZERO DISPLAY
                                                NEXT BYTE
4213  0D                    DEC   C             DECREMENT LINE COUNT
4214  C8                    RET   Z             IF LINE COUNT IS ZERO RETURN TO CALLER
4215  18 E7                 JR    DUMPX         DISPLAY NEXT LINE
4217  3E 00        SEARCHS  LD    A,0           RESET FLAG
4219  32 AA 40              LD    (SFLAG),A
421C  2A 9E 40              LD    HL,(SADD)     GET FIRST ADDRESS OF BLOCK
421F  ED 4B A0 40           LD    BC,(AMTS)     GET LENGTH OF BLOCK
4223  ED 5B A2 40           LD    DE,(WORD)     GET DATA
4227  7A           NEXTL    LD    A,D           GET FIRST BYE OF DATA
4228  BE                    CP    (HL)          IS IT EQUAL TO DATA
4229  28 09                 JR    Z,EXTND       YES - CHECK SECOND BYTE
422B  23           INCHL    INC   HL            NO - GET NEXT ADDRESS
422C  0B                    DEC   BC            DEC SEARCH COUNT
422D  3E 00                 LD    A,0           CHECK IF COUNT IS ZERO
422F  B0                    OR    B
4230  B1                    OR    C
4231  20 F4                 JR    NZ,NEXTL      NO - CONTINUE SEARCH
4233  C9                    RET                 YES - SEARCH FAILED
4234  7B           EXTND    LD    A,E           GET SECOND BYTE OF DATA
4235  E5                    PUSH  HL            SAVE MEM LOCN
4236  23                    INC   HL            GET NEXT LOCN
4237  BE                    CP    (HL)          IS IT THE SAME
4238  28 03                 JR    Z,SUCC        YES
423A  E1                    POP   HL            NO - RESTORE MEM LOCN
423B  18 EE                 JR    INCHL         CONTINUE WITH SEARCH
423D  E1           SUCC     POP   HL            GET ADDRESS IN WHICH FIRST BYTE WAS FOUND
423E  22 9B 40              LD    (DLOC),HL     SAVE FOR DUMP
4241  CD F5 41              CALL  DUMPH         DO DUMP
4244  C9                    RET
4245  3E 00        MOVES    LD    A,0           RESET FLAG
4247  32 AB 40              LD    (MFLAG),A
424A  2A A5 40              LD    HL,(MADD)     GET ADDRESS OF SOURCE BLOCK
424D  ED 5B A7 40           LD    DE,(DADD)     GET ADDRESS OF DESTINATION BLOCK
4251  ED 4B A9 40           LD    BC,(AMT)      GET BLOCK LENGTH
4255  ED B0                 LDIR                MOVE DATA
4257  C9                    RET
4258  18 09        EXECS    JR    SAVPC         PUT PC ON STACK FOR RETURN
425A  3E 00        EXEC1    LD    A,0           RESET FLAG
425C  32 AE 40              LD    (EFLAG),A
425F  2A AC 40              LD    HL,(EXECL)    GET ADDRESS OF USER ROUTINE
4262  E9                    JP    (HL)          CALL USER PROGRAM
4263  CD 5A 42              CALL  EXEC1
4266  C9                    RET
4267  CD 20 0F     SAVE     CALL  0F20          SET FAST MODE
426A  CD F5 02              CALL  02F5          SAVE DATA
426D  CD 2B 0F              CALL  0F2B          SET SLOW MODE
4270  C9                    RET
4271  00                    NOP
4272  00                    NOP
4273  00                    NOP
4274  00                    NOP
4275  00                    NOP
4276  00                    NOP
4277  00                    NOP
4278  00                    NOP
4279  00                    NOP
427A  00                    NOP
427B  00                    NOP
427C  00                    NOP
427D  2A 0E 40     NLINE    LD    HL,(DF-CC)    GET START OF INPUT LINE
4280  22 95 40              LD    (INPUT),HL    RESET INPUT POSITION
4283  22 99 40              LD    (FSTART),HL   SET START OF FIELD TO LOCATION FIELD
4286  CD 65 41              CALL  DLOCX         DISPLAY LOCATION AND CONTENTS
4289  C9                    RET
428A  2A 99 40     FUNC     LD    HL,(FSTART)   GET START OF FIELD
428D  ED 4B 0E 40           LD    BC,(DF-CC)    TEST IF IN LOCATION FIELD
4291  B7                    OR    A             CLEAR CARRY FLAG
4292  ED 42                 SBC   HL,BC
4294  20 1C                 JR    NZ,FVAL       NOT LOCATION FIELD
4296  ED 5B 99 40           LD    DE,(FSTART)
429A  CD A4 41              CALL  ADDRX         GET HEX ADDRESS FROM INPUT
429D  22 92 40              LD    (LOCN),HL     SAVE IN LOCN
42A0  7E                    LD    A,(HL)        GET CONTENTS
42A1  13                    INC   DE            INC. SCREEN ADDRESS
42A2  ED 53 99 40           LD    (FSTART),DE   SET START OF INPUT FIELD TO VALUE FIELD
42A6  ED 53 95 40           LD    (INPUT),DE    SET CURSOR POSITION TO START OF FIELD
42AA  32 94 40              LD    (VALUE),A     SAVE VALUE
42AD  6F                    LD    L,A
42AE  CD 8C 41              CALL  DATA          DISPLAY VALUE ON SCREEN
42B1  C9                    RET
42B2  ED 5B 99 40  FVAL     LD    DE,(FSTART)   GET START OF VALUE FIELD
42B6  CD B2 41              CALL  DATAX         GET HEX VALUE
42B9  7D                    LD    A,L
42BA  2A 92 40              LD    HL,(LOCN)     GET LOCATION
42BD  77                    LD    (HL),A        PUT VALUE IN LOCATION
42BE  23                    INC   HL            INC MEMORY ADDRESS
42BF  22 92 40              LD    (LOCN),HL     SAVE NEW ADDRESS
42C2  ED 5B 0E 40           LD    DE,(DF-CC)
42C6  CD 84 41              CALL  ADDS          PUT NEW ADDRESS ON SCREEN
42C9  13                    INC   DE            INC. SCREEN ADDRESS
42CA  7E                    LD    A,(HL)        GET CONTENTS OF NEW ADDRESS
42CB  32 94 40              LD    (VALUE),A     SAVE CONTENTS
42CE  6F                    LD    L,A
42CF  CD 8C 41              CALL  DATA          DISPLAY CONTENTS
42D2  2A 99 40              LD    HL,(FSTART)   GET START OF FIELD
42D5  22 95 40              LD    (INPUT),HL    SET CURSOR TO SRAT OF FIELD
42D8  C9                    RET
42D9  CF           COPY     RST   8             RETURN TO BASIC
42DA  00                    NOP
42DB  00                    NOP                 42DF  00          NOP
42DC  00                    NOP                 42E0  00          NOP
42DD  00                    NOP                 42E1  00          NOP
42DE  00                    NOP                 42E2  00          NOP
```

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HAVE MICRO, WILL

John Dawson argues the case for portability. He shows that the idea of a micro in a suitcase — or in this instance, a camera case — need not be the preserve of relatively costly machines such as the Osborne.

PORTABILITY AND communications are becoming important trends in micro-computing. The Information Technology revolution that is going on at the moment will create a demand for information away from orthodox outlets such as Telex machines, VDUs attached to mainframe computers and static microcomputers.

The Osborne 1 microcomputer exemplifies one approach to portability — considerable processing power with large-scale data storage in a man-portable pack. In the early photographs advertising the Osborne 1 a comparison was made between two men, one with an ordinary briefcase containing sandwiches and papers, and the second with the computer. Leaving aside the advertising claims I was always fascinated by the white knuckles of the man carrying the computer — just how much did it weigh?

The other approach is a genuinely portable terminal with limited storage but with the capability to access huge databases by way of the public telephone network. The IXO telecomputing system described in the April 1982 edition of *Byte* magazine is a fine example of the shape of things to come.

Pocket terminal

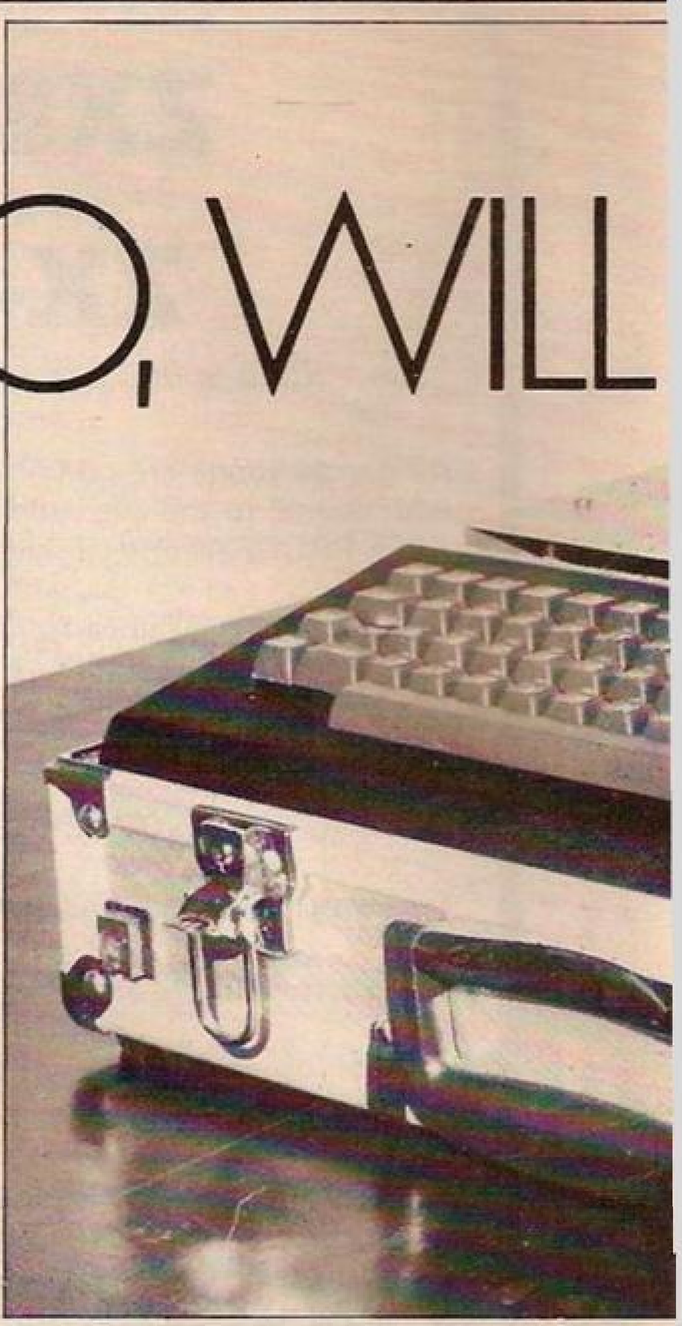
The IXO terminal is about 6in. long by 4in. or 5in. deep, is truly user-friendly, with excellent ergonomic design, and has a single-line liquid-crystal display with a QWERTY keyboard. There is a telephone Modem inside, good security protection to make it difficult for an unauthorised person to use your terminal, or their own, to access one of your files on the main computer, and the protocol you require to access a database can be stored automatically in CMOS RAM.

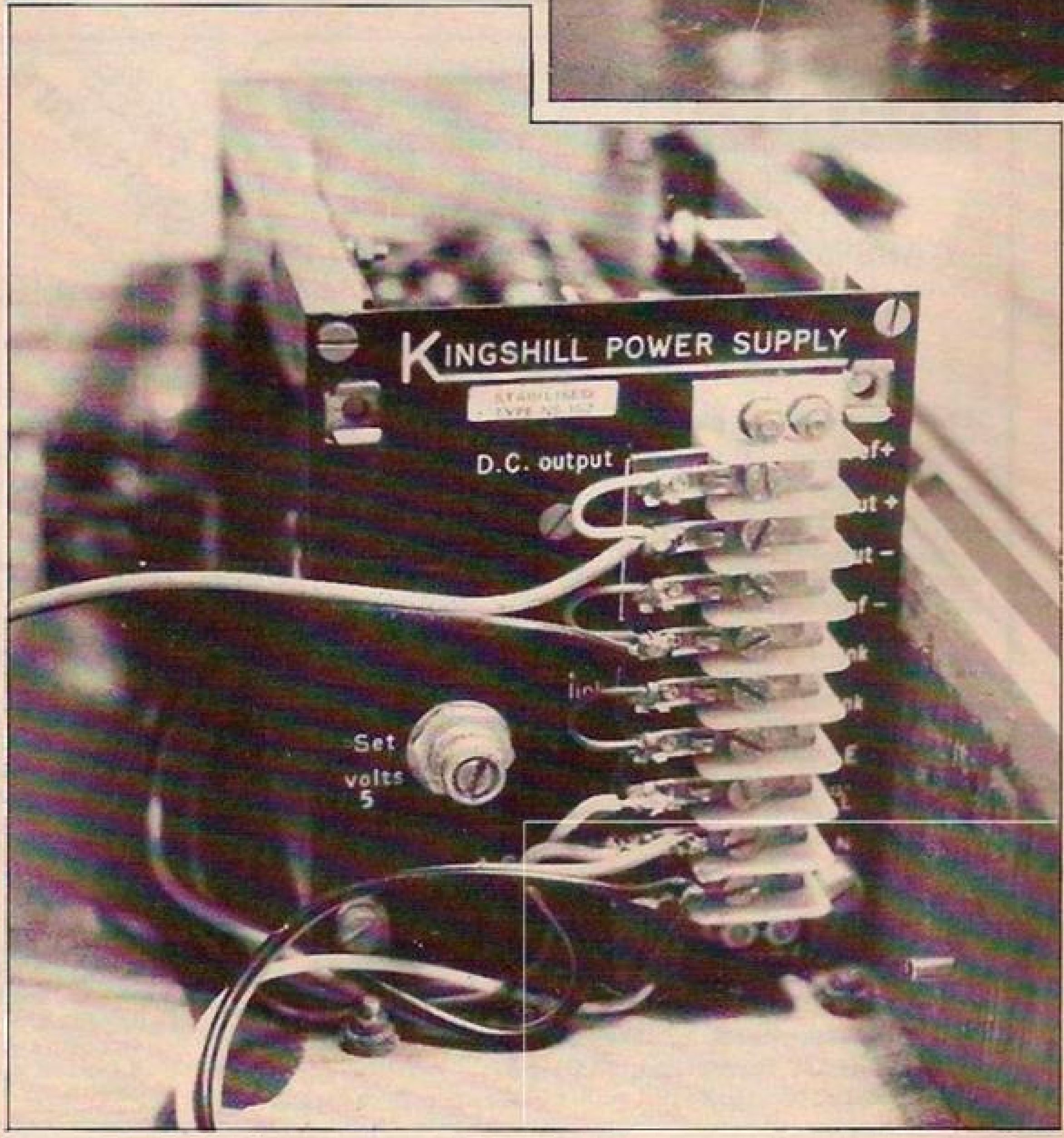
EPSON is launching the HX-20 in the States, a portable computer working on Nicad batteries with a four-line liquid-crystal display 24 characters wide which will display upper- and lower-case letters as well as the rest of the ASCII set.

These new computers and devices are not just marketing gimmicks. The ability to utilise the power of a computer in several places has already been shown to be very valuable. For example, Government officials with terminals coupled to a main computer by an acoustic coupler have been helping farmers in the U.S.A. for years.

Doctors in this country have used portable data capture units for analysing the electrical activity of the heart for some time, and when you couple a computer, rather than a dumb terminal, to a central store of information, the sky's the limit.

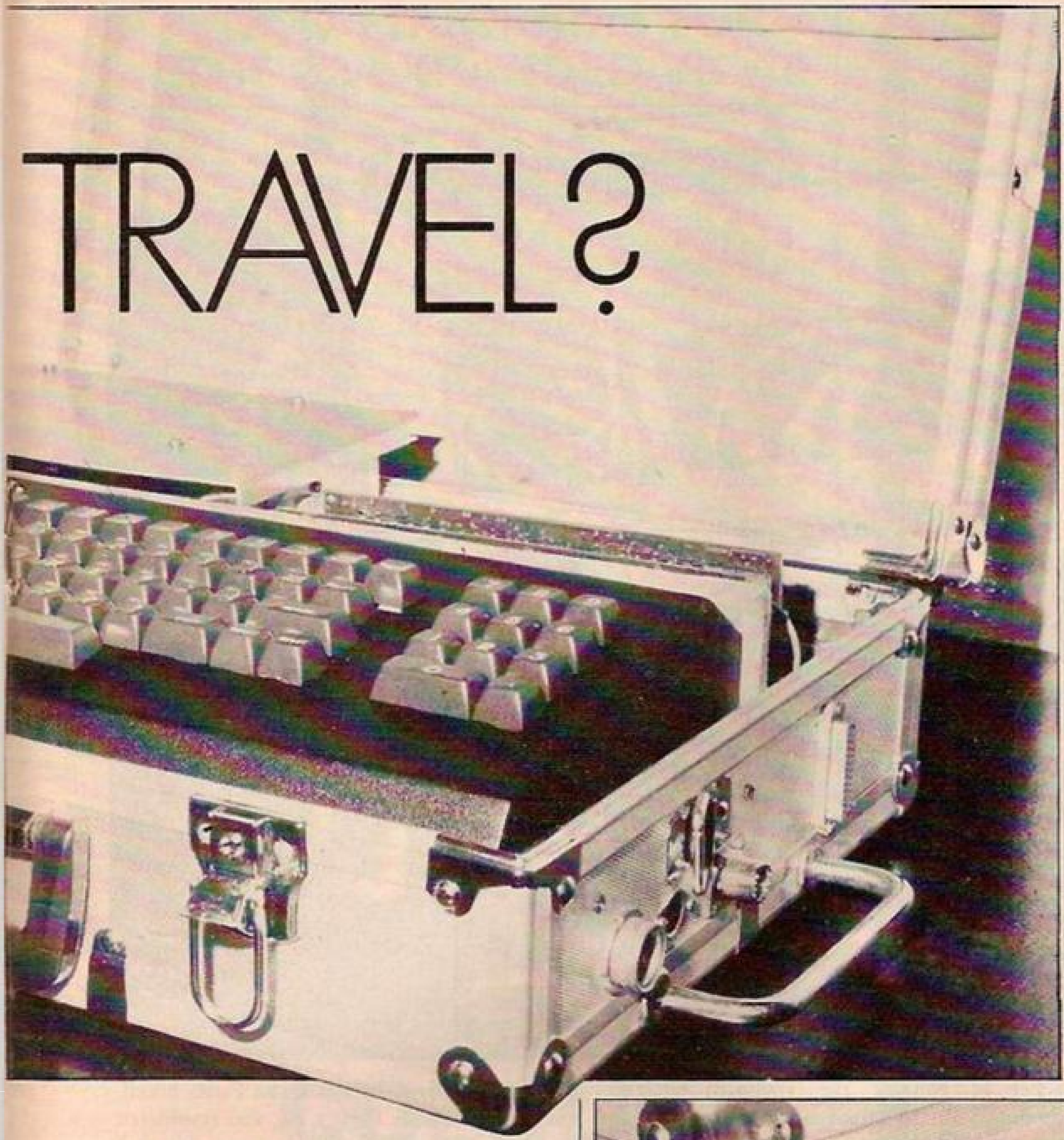
Having just finished writing Asimov, a word-processing package for the Tangerine Microtan, I wanted to be able to work on papers and reports both at the office and at home. I could have bought another Microtan solely for the office and it would have been fixed there with the same trailing wires; but at the same time someone at work said that she wanted a word processor for articles, press releases and a book.





Below, the 5V PSU mounted inside the camera case. Right, the micro that fits so neatly into the case is mains-powered but could run for several hours off a battery pack. Far right, the connections to the word processor.

TRAVEL?



It seemed a good opportunity to share the use of a portable word processor. The main photograph on this page shows the result of a weekend's work putting a new computer into a portable case.

When I planned the project it seemed reasonable to assume that a television would be available wherever the machine would be used. There is a TV in most homes, colleges, conference centres and hotel rooms for someone who is travelling. Consequently, there is no VDU built into the unit.

Railway work-station

If you want to use it on a train, you will need a battery pack for the computer, like the Osborne 1, and a battery-powered TV. Printers are still expensive so I decided that it would be an acceptable compromise to prepare material on the portable work-station, store the text on to tape and then print the text on my own computer at home.

The text would be transported either as a finished cassette tape or electronically along a telephone line. This is essentially the same method as a remote work-station in an office preparing text and then printing the final document on a central printer.

I like the Tangerine keyboard very much and I wanted to incorporate it into the unit without modification, so the computer case had to be wide enough to take the keyboard in its steel plinth. After rummaging through several luggage shops I found a version of the case I finally bought but it seemed over-expensive.

The same case is sold by Dixons camera shops as the Chinon Corniche, costing £29.95. The Corniche is about 17in. wide inside and is 5.25in. deep, about 0.75in. taller than the Microtan boards.

Asimov can manipulate about 7,500 words when used with a fully-expanded Microtan — or approximately 900 words with a full Tanex board — and I wanted to leave room for a TanRAM card in addition to the central processor unit and the several Tanex boards.

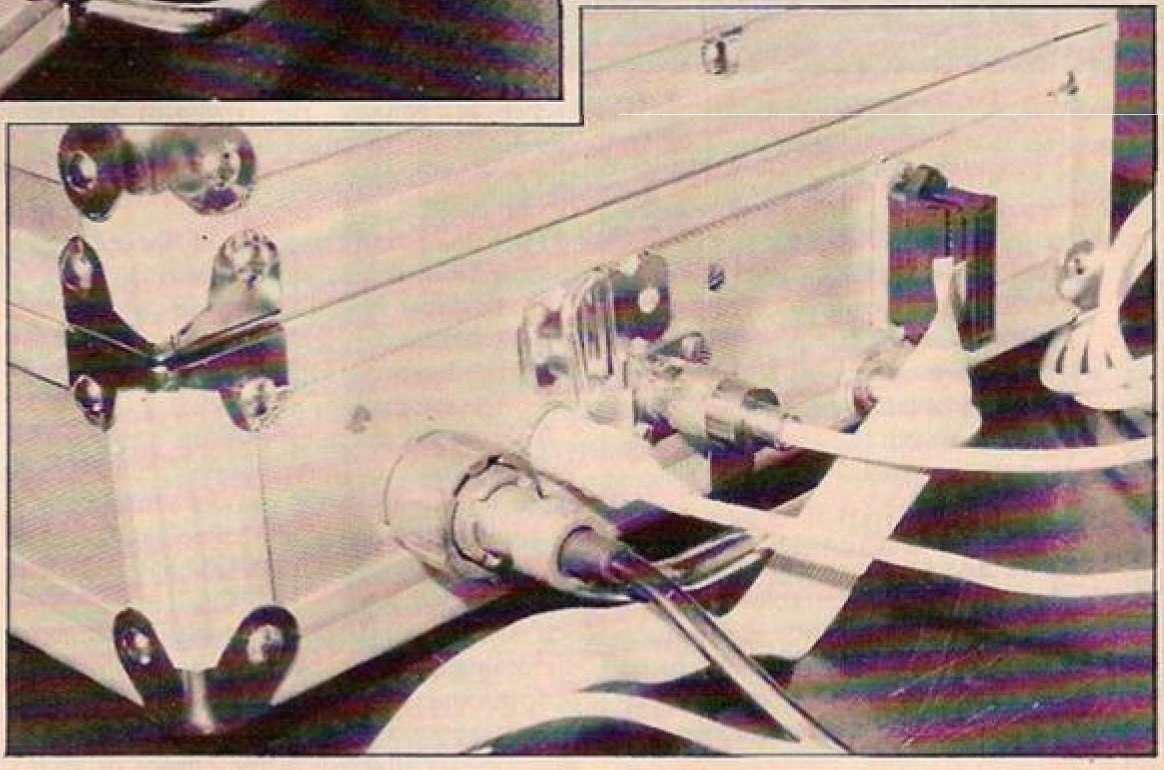
Furthermore, Microtanic Software which is marketing Asimov, is also bringing out a high-resolution board that will give a screen 64 characters wide by 25 lines and I wanted to take account of that in the space left for future expansion.

The case shown in the photographs has a number of features that are particularly well suited to this purpose. It is constructed out of plywood with a thin aluminium veneer on the outside and is quite rigid. Plugs and sockets can be mounted directly on to the case and the metal skin can be connected to the mains earth without difficulty. The plywood is strong enough to support a surplus mains power pack for the computer. Indeed, fixing the power pack in three places to two different panels strengthens the case.

I stripped out the fancy foam padding and ribbed side decoration and when I had secured the power-supply unit, I played with the computer boards, the keyboard and the tape recorder for some time.

Was there an advantage in having the boards lying flat, and stacking one on top of another? What effect would that design have on the ventilation of the boards? Did the keyboard fit over the tape recorder and, if so, was that an efficient use of space, leaving room for the connecting cables?

What about electrical safety? Could I bring mains power round to the right-hand side of the case, close to the signal wires, without inducing mains noise and corruption on the cassette and keyboard leads?



I only constructed the computer after a good deal of thought. Destroying the guarantee on £30's worth of case by drilling holes in it is always rather an anxious business, but it turned out well.

The keyboard rests on two side steps when it is in the case and the steps are deep enough to support the keyboard sufficiently clear of the National Panasonic Slimline tape recorder to store some cassette tapes between the two.

The mains input is on the left-hand side of the case and a lead is taken underneath the left-hand step to a neon light on the front surface.

(continued on next page)



(continued from previous page)

There is no on/off switch; when you plug the computer in, it is on.

I completed the mains wiring before doing anything else, bringing a lead out to the right side for the tape-recorder power. The next step was to fit the keyboard and measure the space remaining for the computer boards. I used a spare mini-motherboard and mounted the CPU and Tanex cards upright and as close to the partition between the keyboard and the rest of the case as possible.

Screen expansion

By hand-wiring a bus to two or more Eurocard sockets, I expect to be able to fit the TanRAM and big screen boards in the space at the back of the case. The aluminium panel separating the power-supply unit from the computer is bolted to the back of the case and to the unit.

It is carefully earthed both to act as a Faraday screen and to protect the computer should a mains lead come astray from the input to the power-supply unit.

The 16-pin dual-in-line plugs and sockets were never designed for frequent connection and disconnection; if you do not believe me look at the amount of metal in the Military Specification socket shown in photograph 9 and remember that it was designed to cope with salt water, mud, vibration and parachute drops.

Accordingly, I cut the keyboard cable on the Microtan and used a 25-way D plug and socket to connect the keyboard to the computer. Radio Shack has plastic D plugs and sockets with fittings to couple directly to ribbon cable.

The clamp on the back of the plug is comparatively fragile and it is easy to break the side arms that hold the back in place. The chrome bar on the right-hand side of the case is intended to protect the sockets from damage when the computer is moved.

Before doing anything with the computer I switched on the power-supply unit and checked the mains volts and the output volts. Remember to switch off before going anywhere near mains voltages — at 230V AC, the mains can kill you.

If you want to check mains voltages connect the multimeter and then switch on to obtain your reading. If it is impossible to do that then at least keep one hand in your pocket which will substantially reduce the chance of your receiving a shock through both hands across your heart.

The output socket from the modulator on the Microtan protruded too far and I removed the socket, soldering a coaxial lead directly to the unit. When I plugged the central-processor unit board into the motherboard and switched on, it worked. When I plugged the Tanex board in beside the CPU card and switched on it functioned until I added a full set of RAM chips.

Then it worked for just half a second before failing completely. There was no time to see an organised pattern on the VDU and then the screen went blank. I checked the Tanex board, which I had made from a kit, and resoldered many of the joints, looking always for thin whiskers of solder that might short out the power supply. Nothing obvious, even under a magnifying glass.

Eventually I connected a low resistance across the power-supply unit with a multimeter in series to measure the current the unit would put out before it shut down. After adjusting the current limiting variable resistance to allow the supply to give at least 1.5A, I reconnected the computer and the Tanex boards. This time it worked; it was just coincidence that the difference in current drawn by the Tanex board with the full complement of RAM was sufficient to shut down the power-supply unit.

CONCLUSIONS

- The whole case weighs about 10 kgm. when it is packed.
- Asimov is easy to use, and the VDU sits comfortably on top of the computer case — the facility to do work on a word processor and to take the machine with you at night or at the weekends is splendid.
- If flat screens are developed to the stage where they are cheap and reliable in the near future I shall be tempted to mount one in the lid of the computer case so that I can write on the commuter train.
- The final touch would be an acoustic coupler to transmit and receive text down a telephone line. ■

RESPONSE FRAME

Do you have a problem? Your manual is incomprehensible or you just cannot get the hang of that programming trick you tried — whatever it is, Tim Hartnell will do his best to answer your queries. Please include only one question per letter and mark them "Response Frame".

IS IT WORTH IT?

■I own a 1K ZX-81 and want more memory. Is a Vic-20, BBC Micro or Acorn Atom worth the extra money when compared with expanding the ZX-81? If so, do they run on Pet, or similar, Basic?

Edward Hogarth, Preesall, Blackpool.

THE REAL ANSWER must begin "it all depends". It all depends on what you want to do with your microcomputer. Certainly, if you want music, colour, reliable Load/Save and Pet Basic, the Vic-20 is worth the money. If you want a computer with high-resolution graphics that you are unlikely to outgrow for years, the BBC Microcomputer is worth the money. Certainly if you do not mind working in what Clive Sinclair once called an "arcane" version of Basic, and you want a good reliable machine, which positively begs you to experiment with assembler, the Acorn Atom is worth the extra money. Sinclair's new Spectrum, reviewed on page 20, may also be worth considering. First, determine exactly what you need to make the most of your microcomputer, then examine the computers you can afford.

WHAT PRICE FAME?

■I write Basic programs, and I imagine — like the majority of others — partly for their applications, but mostly for the fun of it. However, there are occasions when, having spent many evenings writing, testing, and debugging a program, one thinks that it would be good to earn a little cash for one's labours — perhaps to buy a printer. Do you think it would be possible for *Your Computer* to provide some information on the possibilities which are available, assuming that one does not want to get involved in setting up one's own business? For example, can one sell programs to the many small software firms which advertise monthly in *Your Computer*, and what is the situation regarding copyright?

Terry Peppard, Redhill, Surrey.

THE EASIEST thing to do is to give software companies the right to duplicate and distribute the programs on your behalf. We would suggest you approach the bigger companies first — such as Bug-Byte, Artic or Premier Publications — as they are most likely to have a well-structured arrangement in existence to cater for such situations. You automatically have the copyright for any original work — be it a musical composition, a book, a computer program, or whatever — but you cannot expect to have the rights to some program you have merely adapted from a published listing. It is best, in terms of financial return, to sign a rights deal only, rather than sell a program outright. *Your Computer* also pays £6 for every Software File contribution published and £35 a page for articles in the main section of the magazine.

THINK OF A WORD

■I have had a Vic-20 for some weeks now and am pleased to see that *Your Computer* is devoting more and more space to the Vic. I wish to write a program in which the Vic thinks of a word, rather than a number, but I cannot work out a way to make the Vic think of a different word, short of having all the words in one string, and having the computer select a part of the string. I would be very grateful if you could suggest a way for me to do this.

S Harnwood, Irvine, Scotland.

IF YOU HOLD the words in Data statements, you just need to have:

```
FOR J = 1 TO INT(RND(1)*X)
```

where X is the number of words in the list

```
READ A$, NEXT J
```

This will move through the list a random distance, ending with one word equal to A$. Of course, if you decide to find another word at random during the same game, you will need to add a Restore statement before the opening of the J loop.

IT WAS THIS BIG

■I own a 16K Sinclair ZX-81, and wonder if you could suggest a short program telling me how much free memory I have left in my machine while I am entering a program.

J Taylor, Askam-in-Furness, Cumbria.

A ONE-LINE program which will help you assess free memory is

```
9999 PRINT PEEK 16396 + 256 * PEEK
     16397 — 16509
```

Just enter Goto 9999 when you want to find out how much memory your current program has used.

EASY AS ABC

■Having just acquired a ZX-81, I looked through numerous computer magazines and found you are the most interesting and helpful, and I have ordered a copy every month. I have been looking for a program which I can use which would take a random list of items and put them in alphabetical order. So far I have had no success, and I wondered if you could help me with such a program. I am building a library of records, and am now using my ZX-81 to list them, but it would be of great help if the list appeared in order.

C N McPherson, Harrow.

THE FOLLOWING program should suit your needs. It will run in one 1K, although you will only sort a limited number of items with that small memory. If you would like it to list items in the opposite order to the one it now uses, change line 175 to

```
FOR T = Q/Q TO Q
```

Thank you very much for the comments on *Your Computer*.

```
  1 REM ALPHASORT
  2 PRINT "NO. TO BE SORTED?"
  3 INPUT Q
  4 CLS
 40 DIM A$(Q+1,10)
 50 FOR T=Q/Q TO Q
 60 INPUT A$(T)
 70 NEXT T
 80 FOR Z=Q/Q TO Q
 90 FOR T=Q/Q TO Q
100 LET B$=A$(T)
110 IF A$(T+T/T)>=A$(T)
    THEN GOTO 130
120 GOTO 150
130 LET A$(T)=A$(T+1)
140 LET A$(T+1)=B$
150 NEXT T
160 NEXT Z
175 FOR T=Q TO Q/Q STEP
    -Q/Q
180 SCROLL
190 PRINT A$(T)
200 NEXT T
```

1K ADVENTURE

■I am 12 years old and have recently bought a Sinclair ZX-81. In countless magazines I have seen adventure games for higher-memory computers. As you know, this standard machine only has a 1K RAM, and I have never seen an adventure game for a 1K ZX-81. My money resources will probably never expand to buying a Sinclair 16K RAM. Could you possibly tell me where I can find a program of adventure for a 1K computer?

Lee Jolly, Preston, Lancashire.

THE SHORT ANSWER is no. There is no way you can fit an adventure into 1K. The longer answer is made up of three possibilities:

- ■You buy cheaper expansion memory. 3K packs are available for around £15.
- ■Alastair Gourlay's book *34 Amazing Games for the ZX-81* has a 1K Wumpus game in it which, although necessarily limited, is possibly of interest.
- ■You take advantage of the fact that the ZX-81 can store variables such as

```
LET A$ = "A BIG BAD BOOGY"
```

when entered directly, and these can be used in a game if you use Goto 1, rather than Run.

BBC GAMES

■I have written a board game for my BBC Microcomputer, and although the display — using full stops, the letter H for the human piece and C for the computer piece — is satisfactory, I would like it to place each piece in a particular colour. How can I do this?

John O'Rorke, West Ruislip.

IF YOU USE the line:

```
F = - 130*(M=67) 133*(M=72)
  - 134*(M=46)
```

and you are working in Mode 7, you can follow it, if M is the code of the piece, with the line

```
PRINT CHR$(F);CHR$(M);
```

to obtain purple Hs, green Cs and light-blue full stops. Change the numbers before the brackets in the first line given to produce different colours for the pieces.

IS VIC THERE?

■I read about the Super Vic in *Your Computer*. I was about to buy a Vic-20, but now I am worried that the Super Vic will replace the Vic-20 in the same way as the ZX-81 did the ZX-80. Could you tell me more about the Super Vic and if the Vic-20 is expandable for a similar price?

M P Eaglen, Wroxell, Isle of Wight.

THE SUPER VIC provides 40 characters per line, and more on-board memory than the Vic-20. Although this is much better than the Vic-20, the standard Vic is available now, and it is possible to obtain high-resolution graphics through a software routine. You may be waiting a long time for the Super Vic to be available in the U.K. Therefore, there seems little point in delaying your purchase. More information about the whole Commodore computer range, including the new Ultimax, can be obtained at the Commodore show in June.

HEAVY KEYBOARDS

■I am looking for a heavy-duty keyboard that will house my ZX-81. The two that have attracted my attention are the Fuller FD system and the Protos keyboard, both recently advertised in *Your Computer*. I was wondering which one of these is the better, or if there is a better one on the market. My price range is £70.

Simon Tyler, Warrington, Cheshire.

YOU HAVE NOT specified what you mean by heavy-duty so it would be difficult to recommend a particular keyboard. For a detailed account of ZX-81 keyboards read Stephen Adams' article in this issue. ■

FINGERTIPS

Fingertips is our regular calculator column covering calculator news, programming hints and examples of unusual applications. The column is written and compiled by calculator enthusiast David Pringle who is glad to hear of any of your ideas. *Your Computer* pays £6 for each of your contributions published.

WITH AN enhanced 12K ROM Basic, six new programmable function keys and an advanced four-colour graphic printer the Sharp PC-1500 is a new, super-improved version of the PC-1211. This newly-released machine, which we hope to review fully next month, set me thinking about what we really wanted from the next generation of pocket calculators. Is it really to be a quest for a mini-microcomputer, or will improved Basic with better array and string handling suffice? Indeed, do we want Basic at all? What about memory capacity, peripherals and keyboard layout? If you have any opinions on these matters write in to *Your Computer*, Fingertips.

Dale Cass of Stafford has an interesting program for writing banner messages with the Casio FP-10 printer. To operate, the user simply enters the codes of the letters of the heading into memories M00 to M03. Five letters may be stored in each memory, and each is represented by a two-digit number corresponding to its position in the alphabet. For example, the message *Your Computer* would be entered as

```
25 . 15 21 18 27   in M00
03 . 15 13 16 21   in M01
20 . 05 18         in M02
```

Note the decimal point after the first two-digit code.

This is the only method for entering letters as the calculator has no string-handling facilities. When the numbers have been entered — and terminated by a zero in M03 in this case — p0 is pressed and the message will be printed.

The program works by using Indirect indirect addressing. This simply means that each code number sends the program pointer to a specified memory, in which is stored another 10-digit number. The program reads this number and splits it up into five two-digit numbers. Each of these is interpreted as the indirect address for yet another memory which will contain seven digits: either a 0 or a 1.

Finally, these seven digits are printed as a column with a zero representing a blank and a one representing a block. Hence each code number is interpreted as five columns of seven rows — a five-by-seven matrix for each letter.

As an example, let us take the letter H. The code number under this scheme is simply 08 — the eighth letter of the alphabet. The program now looks for the indirect address, code number +43, which is memory 51 in this case. The memory list shows that M51 contains the number 40.10101040.

The first two digits are split off by the use of the INT function in the program, leading to the indirect address of M40. This memory contains seven ones and is thus printed as a full vertical line. Similarly, the next two digits are split off

INT(100 × FRAC(M51))

and lead to the memory location containing 0.001000. It is now transparent that we will be forming a letter of the form shown in figure 1.

The character codes are stored in the 27 memories from M44 for A to M70 for a large space. It should be noted that if we worked with a smaller matrix, say, five by six, there would be no need for codes greater than 63 ($2^6 - 1$) and we could simply use one series of indirect addressing instead of two.



Sharp's PC-1500 hand-held computer with four-colour printer — is this the right kind of progress?

Program list.

```
M00-70,F-6F 104steps    "; "
                        LBL5
*** P0                  MR3F FRAC x 10 =
1 +/- MinF              Min3F GOTO3
LBL9                    LBL7
1 M+F                   "; "
IND MRF x=0 GOTO0       SAVE invEXE
Min1F                   MR2F FRAC x 100 =
LBL1                    Min2F x=0 GOTO8
43 M+1F                 GOTO2
IND MR1F Min2F          LBL8
LBL2                    " "
IND MR2F Min3F          SAVE invEXE
LBL3                    MR1F FRAC x 100 =
MR3F x=0 GOTO7          Min1F x=0 GOTO9
INT x=0 GOTO4           GOTO1
";██"                   LBL0
GOTO5                        ···095steps
LBL4
```

Memory list.

```
M00-70,F-6F 104steps   M15=      0.011
                       M16=   0.011001
M00= 25.15211827       M17=     0.0111
M01=  3.15131621       M18=   0.011111
M02=     20.0518       M19=        0.1
M03=          0.       M1F=         0.
M04=          0.
M05=      1.E-06       M20=   0.100001
M06=      1.E-05       M21=    0.10001
M07=     1.1E-05       M22=    0.10011
M08=      1.E-04       M23=   0.101001
M09=     1.1E-04       M24=    0.11011
M0F=          3.       M25=    0.11101
                       M26=    0.11111
M10=      1.E-03       M27=   0.111111
M11=   1.001E-03       M28=         1.
M12=     1.1E-03       M29=   1.000001
M13=        0.01       M2F=         0.
M14=      0.0101
```

(listing continued on next page)

If you own a Micro and spend much of your time using machine code you will find the following program from Brendan Kelly of Nottingham most useful. It is a simple program for the Casio FX-3500P to convert to or from any numerical base, he writes. I found it particularly useful while developing machine-code routines for a TRS-80 to which I had limited access and no assembler.

The best way to initialise the program is to key in the following:

```
MODE 0        Kin 5
INV KAC       0.499999999
1             Kin 6
Kin 3         INV PCL
2             MODE 7 0
Kin 4         P1
10
```

Then key in the program itself:

```
Kin 1         X
—             Kout 3
Kout 4        =
Kin ÷ 1       Kin +2
Kout 6        Kout 5
Kin -1        Kin X 3
Kout 1        Kout 1
INV RND       INV X>0
Kin 1         1
X             Kin 3
Kout 4        Kout 2
=             Kin -2
```

Leave LRN mode:

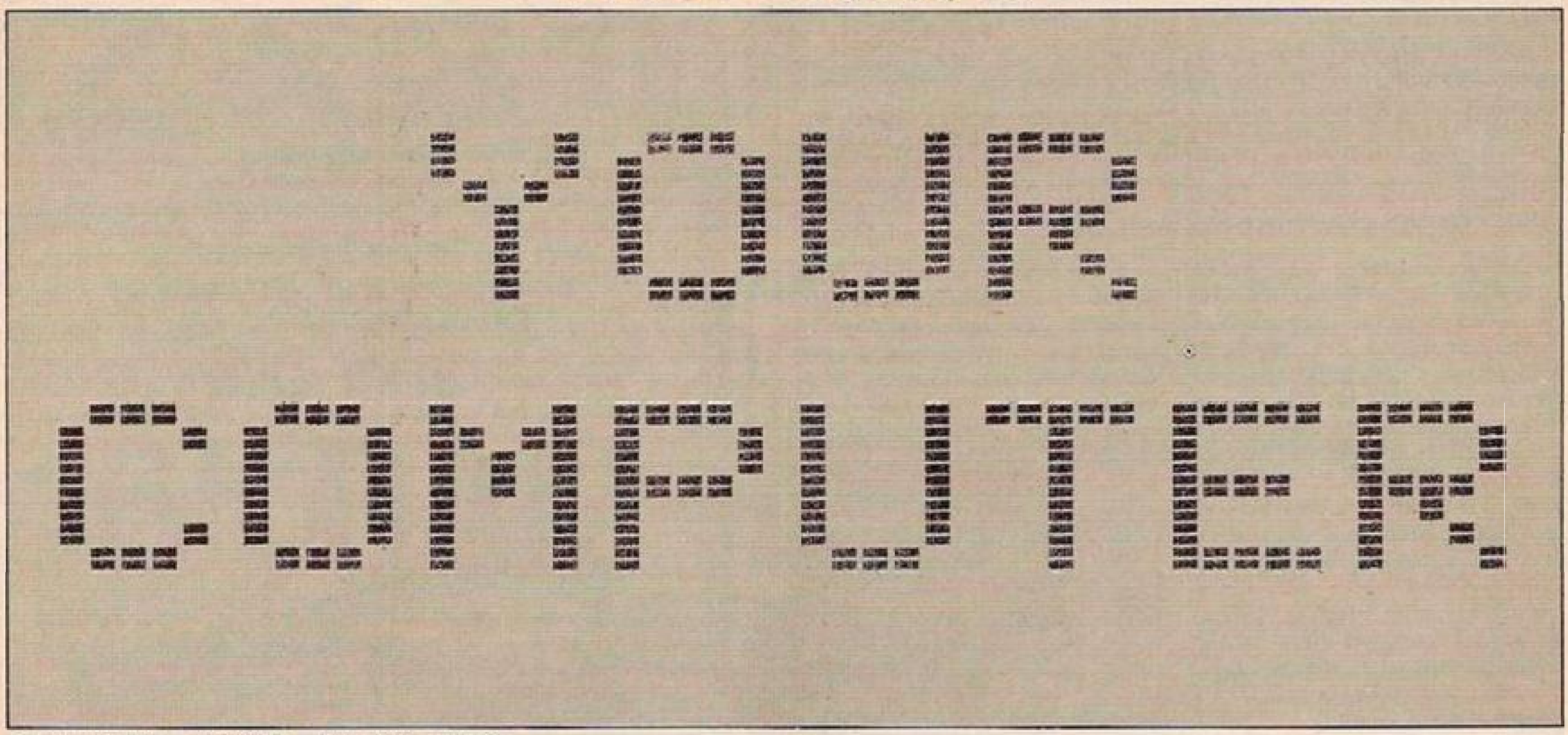
MODE•

As initialised, pressing P1 will

(continued on next page)

Figure 1.

```
10001                      .   .
10001                      .   .
10001                      .   .
11111   or, more clearly   .....
10001                      .   .
10001                      .   .
10001                      .   .
```



Sample printout — actual size — from Casio program.

(continued from previous page)
cause the displayed number to be converted to binary. For example, enter 25, press P1 and after a short pause 11001 will be displayed. The program can then be reused by again pressing P1: reinitialisation is only necessary if the calculator is switched off when Mode 7 0 will have to be re-entered or if the contents of K1 to K6 are inadvertently changed when the values will have to be re-entered.

Obviously, conversion to bases greater than 10, e.g., hexadecimal, cannot be carried out so simply as each digit of the required base, i.e., nybble, will have to be represented by more than one digit of the display.

For example, as the FX-3500P has a purely numerical display, each nybble of hexadecimal will have to be displayed by two digits. Thus 3CFOH would be displayed as 3121500 which could mentally and at a glance be recognised as 3 12 15 00 and if necessary 0 to 15 could be replaced by 0 to F.

To accommodate this method of display not only must the base to which we are converting be stored in K4, but 10^n must be stored in K5 where n is the number of display digits required per digit of the specified base.

The contents of K4 and K5 for conversion to useful bases can be summarised:

	Binary	Hexadecimal	Base 256
K4	2	16	256
K5	10	100	1000

Conversion to base 256 is useful for splitting addresses into their least- and most-significant bytes. For example, 32767 will be converted to 127255.

The main point not so far covered is conversion from rather than to a specified base. This could hardly be simplier and is accommodated by exchanging the contents of K4 and K5. This should cause no added difficulty as long as the strict format of entry is adhered to. That is, 3CFO hexadecimal must be entered as 3121500 not 312150, and 64 0 base 256 must be entered as 64000.

Once this program is understood it can be simply adapted for almost any programmable calculator which uses an algebraic hierarchy, has at least six memories and a conditional jump. The instructions which may require explanation are:

Kin 4	store in memory 4.
Kout 4	recall in memory 4.
Kin + 2	sum to in memory 2.
INV X>0	return if x, the display, is greater than 0 to the first program.
P1	causes execution from the first program step.
INV RND	rounds the internally stored number to that displayed — fixed to 0 decimal places.

A simple, but pleasing, timing program for the Sinclair Enterprise Programmable comes from John Lewis of Llanelli. This is a much shorter program than is supplied in the Sinclair applications books, he writes. When run, it will time accurately over long or short period timings, giving a readout in seconds.

Before each run, you should first key in 0 Sto 0. This sets the timer to zero, as subsequent readings will be stored in Mem 0. Again, after each run, RCL 0 should be keyed in to provide a reading in seconds.

Pre-execution: 0 STO 0

KEY	STEP
= /EE	01
2	02
6	03
M+	04
0	05
GOTO	06
0	07
1	08

Post-execution: RCL 0

Finally, Douglas McGibbon of Edinburgh writes in with two short points on the HP-41C. He writes: the first item is a small program designed to eliminate the laborious task of manually deleting various memory registers when you cannot use the CLRG function because you want to keep some of the registers intact.

The program itself only occupies 24 bytes of memory space and uses the X and Y stacks to hold the limits of the memory clear. Once the program has been loaded and assigned to a key, all that need be done is to enter the upper limit of the memory wipe into the Y stack and the lower bound into the X stack and then execute the program. For example,

8 ENTER 3 R/S

will delete registers 3 to 8 inclusive.

```
01 LBL αMOPα
02 LBL 00
03 STO IND X
04 ST  IND X
05 X=Y?
06 STOP
07 1
08 +
09GTO 00
10 END
```

Secondly, in the manual it is stated that memory modules should always be inserted in the correct order, so I moved my sole memory module from port 1 to port 2. After a little experimentation I discovered that I had a block of memory that could be used as memory registers only and not as program registers.

As to be expected these registers were numbered in the conventional pattern as if there was a module in port 1 also. That is, from a cold start with a module in port two, the new block of registers is numbered 81 to 144. The most interesting finding was that although the statistical registers can be assigned to this block, the shifted set of registers is not affected by the CLRG function. This provides another use for my program.

This immunity is apparently because of the fact that when the CLRG function is executed, the calculator only checks the first port for extra modules. On finding none, it assumes no extra modules are plugged in and stops where it is. It is also possible to store something in a register, move the module to a different port and recall it by using the new register number. ■

(listing continued from previous page)

```
M30=   1.000011   M40=   1.111111   M50= 26.29333325   M60= 26.29342035
M31=   1.000101   M41=   0.11001    M51=  40.1010104   M61= 40.11162332
M32=   1.00011    M42=          0.  M52=  4.29402904   M62= 22.33333341
M33=   1.001001   M43=          0.  M53= 19.28292705   M63=  5.05400505
M34=   1.010001   M44= 39.11111139  M54= 40.10142129   M64= 27.28282827
M35=   1.01111    M45= 40.33333324  M55= 40.28282828   M65= 18.19281918
M36=   1.100001   M46= 26.29292921  M56=  40.0612064   M66=  40.1915194
M37=   1.100011   M47= 40.29292117  M57=  40.0810134   M67= 37.14101437
M38=      1.111   M48= 40.33333329  M58= 26.29292926   M68=  7.08380807
M39=    1.11111   M49= 40.11111105  M59= 40.11111109   M69=  36.3433313
M3F=         0.   M4F=          0.  M5F=          0.   M6F=          0.
                                                       M70=  4.04040404
```

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Code transfer

Nick Goodwin, Eyemouth, Berwickshire.

ZX-81

IF YOU ARE experimenting with machine-code programming on the ZX-81 the moment will arrive when you want to incorporate a machine-code routine, which you have in one program, into another program. This can present a problem, since machine codes are often long and laborious to enter. The following process, however, enables machine code to be transferred from one program to another with a minimum of effort, and error-free.

First, RAMtop must be set at some convenient level. I generally set it at 32000 for this kind of work, which gives 768 bytes to play with, while leaving well over 15K for Basic listing, display file and variables.

The following routine enables RAMtop to be set easily at any desired level:

```
10 INPUT X
20 LET Y=INT (X/256)
30 LET X=X-256*Y
40 POKE 16388,X
50 POKE 16389,Y
60 NEW
```

Run the program, enter the number to set RAMtop, press Newline. The program promptly disappears — line 60. If you want to check that you have set RAMtop correctly, the following command will print the number you entered:

```
PRINT PEEK 16388 + 256*PEEK 16389
```

Now load the program containing the machine-code routine which you want to isolate and transfer. I assume here that the machine-code routine is stored in a Rem statement in line 1, but the program can easily be adapted by adjusting the initial value of J in line 9030. This should be the address prior to the address at which the machine-code routine commences.

Add the following lines to your listing. I have chosen to number them from 9000 but that is not important — simply slot them in where you can.

```
9000 FAST
9010 LET RAMTOP=PEEK 16388+256*PEEK
     16389
9020 LET X$=" "
9030 LET J=16513
9040 LET J=J+1
9050 IF PEEK J=118 THEN GOTO 9080
9060 LET X$=X$+S TR$ PEEK J + "(inverse
     space)"
9070 GOTO 9040
9080 FOR J=1 TO LEN X$
9090 POKE RAMTOP+J, CODE X$(J)
9100 NEXT J
9110 STOP
RUN 9000
```

When that has finished a few seconds later, load the program to which you wish to transfer the machine-code routine. Again, I assume that you want to Poke the routine into a Rem statement in line 1, but this can be changed by altering the initialising value of J at line 9010 to the address prior to that at which you want the machine-code routine to start.

First, you must reserve some space in the normal way:

```
1 REM XXXXXXXXXXX . . .
```

Note that, using this routine, it is not critical that you enter the correct number of Xs at the first attempt. If you are short, the program will stop and tell you, so you can add some more. If you enter too many, it is a simple matter to edit them out afterwards.

```
9000 FAST
9010 LET J=16513
9020 LET R=PEEK 16388+256*PEEK 16389
9030 LET X$=" "
9040 LET R=R+1
9050 IF PEEK R=128 THEN GOTO 9090
9060 IF PEEK R=0 THEN STOP
9070 LET X$=X$+ CHR$ PEEK R
9080 GOTO 9040
9090 LET J=J+1
9095 LET X=VAL X$
9100 IF PEEK J=118 THEN GOTO 9130
9110 POKE J,X
9120 GOTO 9030
9130 PRINT "INSUFFICIENT SPACE —
     EXTEND LINE 1 THEN GOTO 9100"
9140 STOP
```

Run 9000, or Goto 9000 if you have data to preserve. When it is done, List; there is your machine-code routine safely lodged in line 1. If you want to tidy the program, edit any surplus Xs from the line.

You may be tempted to simplify this program, by simply copying the Rem statement data as it stands into a literal string and Poking that over RAMtop. However, be warned; that does not always work. Characters that are printed as a ? in the Rem statement are reduced to code 15. Thus, although the line may look identical to the original, it will not, in fact, work as a machine code.

Peek at Pokes

S J Ridgway, Wheathampstead, Hertfordshire.

VIC-20

I OWN A Vic-20 but I have used a Pet before, so I have many programs for the Pet. The main problem with converting Pet programs to Vic are the Poke numbers. So I have made a list that I think will be very useful to many Vic owners which shows the Pet's Poke numbers against the Vic's Poke numbers. The chart also shows the Vic Poke numbers when your machine has more than 8K of memory.

PET MAPPING	VIC MAPPING	VIC COLOUR	VIC 8K+ MAP	VIC 8K+ COL
32768 - 32807	7680 - 7701	38400 - 38421	4096 - 4117	37888 - 37909
32808 - 32847	7702 - 7723	38422 - 38443	4118 - 4139	37910 - 37931
32848 - 32887	7724 - 7745	38444 - 38465	4140 - 4161	37932 - 37953
32888 - 32927	7746 - 7767	38466 - 38487	4162 - 4183	37954 - 37975
32928 - 32967	7768 - 7789	38488 - 38509	4184 - 4205	37976 - 37997
32968 - 33007	7790 - 7811	38510 - 38531	4206 - 4227	37998 - 38019
33008 - 33047	7812 - 7833	38532 - 38553	4228 - 4249	38020 - 38041
33048 - 33087	7834 - 7855	38554 - 38575	4250 - 4271	38042 - 38063
33088 - 33127	7856 - 7877	38576 - 38597	4272 - 4293	38064 - 38085
33128 - 33167	7878 - 7899	38598 - 38619	4294 - 4315	38086 - 38107
33168 - 33207	7900 - 7921	38620 - 38641	4316 - 4337	38108 - 38129
33208 - 33247	7922 - 7943	38642 - 38663	4338 - 4359	38130 - 38151
33248 - 33287	7944 - 7965	38664 - 38685	4360 - 4381	38152 - 38173
33288 - 33327	7966 - 7987	38686 - 38707	4382 - 4403	38174 - 38195
33328 - 33367	7988 - 8009	38708 - 38729	4404 - 4425	38196 - 38217
33368 - 33407	8010 - 8031	38730 - 38751	4426 - 4447	38218 - 38239
33408 - 33447	8032 - 8053	38752 - 38773	4448 - 4469	38240 - 38261
33448 - 33487	8054 - 8075	38774 - 38795	4470 - 4491	38262 - 38283
33488 - 33527	8076 - 8097	38796 - 38817	4492 - 4513	38284 - 38305
33528 - 33567	8098 - 8119	38818 - 38839	4514 - 4535	38306 - 38327
33568 - 33607	8120 - 8141	38840 - 38861	4536 - 4557	38328 - 38349
33608 - 33647	8142 - 8163	38862 - 38883	4558 - 4579	38350 - 38371
33648 - 33687	8164 - 8185	38884 - 38905	4580 - 4601	38372 - 38393
33688 - 33727				
33728 - 33767				

Test of character

Peter Vasey, East Boldon, Tyne and Wear.

BBC

A BRIEF EXPLORATION of the BBC Micro's character set reveals no built-in graphic characters other than some inverse spaces and a weird set of characters which appear to be concerned with controlling the teletext print-out. For example Chr$(141) in conjunction with a two-cycle For-Next loop prints double-height letters. For example:

```
10 MODE 7
20 FOR A%=2 TO 3
30 PRINT TAB(5,A%) CHR$(141) "Hello"
40 NEXT
```

This is very useful for headings and titles. Fortunately the provisional guide has a well-documented section on the use of certain aspects of the VDU command, including the generation of special characters. The command is VDU23,XXX,a,b,c,d,e,f,g,h where XXX is the Chr$ reference, normally restricted between 224 and 255, and the rest of the line is eight eight-bit bytes — the numbers from 0 to 255.

This very useful command can be programmed to generate any required character, but unless one is very familiar with binary numbers or has a full table of numbers from 0 to 255, the programming of each character using graph paper can be very tedious. So I

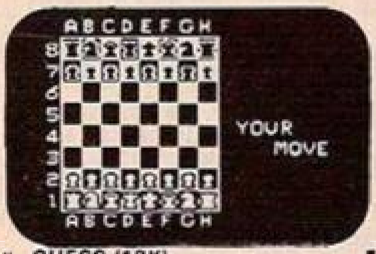
(continued on page 69)

PROGRAM POWER PROGRAM POWER

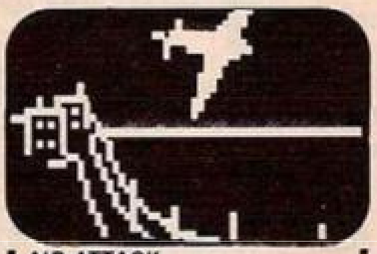
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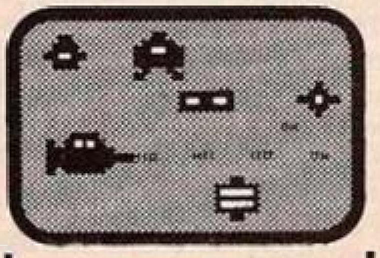
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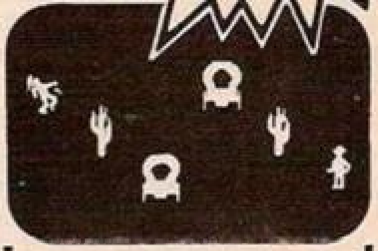
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● STEP	RESTORE	AUTO X, Y	OFF
FIND	ELSE	CURSOR X, Y	VECTOR
VAR	WHILE	BEEP X, Y	ZERO
LVAR	ENDWHILE	KEY X	POP
DELETE X, Y	DUMP	INKEY $X	STOP

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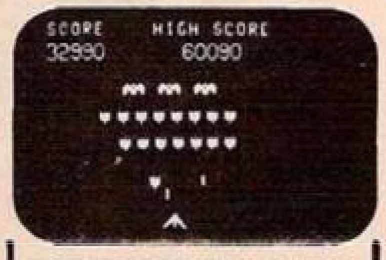
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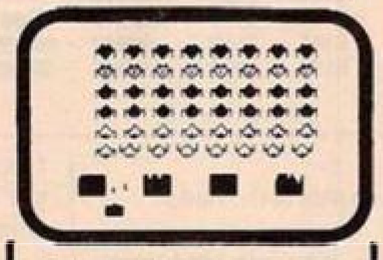
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PROGRAM POWER PROGRAM POWER

(continued from page 67)

wrote this program to assist in designing graphic characters. I have left in spaces and not-used multi-statement lines in the interest of clarity and readability, but approximately 50 bytes can be saved by compressing the listing.

Lines 40 and 50 set function keys 0 and 1 to these numbers to aid speed of entry of the binary-number strings, and a character can be entered in about 30 seconds. Line 220 enters the character into memory and line 230 displays it. The correct VDU statement for generation of the character in question is also given — lines 250 to 290.

```
BBC CHARACTER SET

10  DIM B(7)
20  @%=000010
30  MODE 4
40  *KEY0    0
50  *KEY1    1
60  CLS
70  PRINT TAB(5) "SPECIAL CHARACTER SET PROGRAM"
80  PRINT '"Eight x 8 digit Binary nos. are required. Use
    function keys 0 and 1 for inputs"'
90  FOR X=0TO7
100 INPUT A$
110 A=0
120 PRINT TAB(15,X+5);
130 FOR A%=7 TO 0 STEP-1
140 A=A+(2^A%)*(ASC(A$)-48)
150 IF ASC(A$)=49 THEN PRINT CHR$(240); ELSE PRINT "  ";
160 A$=RIGHT$(A$,A%)
170 NEXT
180 B(X)=A
190 PRINT A
200 NEXT X
210 *KEY1 RUN|M
220 VDU23,250,B(0),B(1),B(2),B(3),B(4),B(5),B(6),B(7)
230 PRINT '"Character is : ";CHR$(250)
240 @%=000001
250 PRINT'"Statement is : "
260 PRINT'"VDU23,XXX,";
270 FOR A%=0 TO 7
280 PRINT B(A%);",";
290 NEXT
300 PRINT''"Press Function Key 1 to rerun"
```

Assault craft

C J Young,
Farnborough,
Hampshire.

ZX-81

THIS PROGRAM for the 16K ZX-81 could be easily converted to machine code, but the Basic version is still very fast, very exciting and flicker-free.

The program uses the full screen of 24 lines of 32 columns as instructed in Timothy Gilbert's February Software File article, by Poking location 16418,0. It also uses the idea expressed by Loll Holt in his November 1981, Software File article on an efficient way to move an object in two directions which is shown in lines 270 and 280.

The aim of the game is to score as highly as possible by destroying the alien ships which travel along any of seven lanes. You have three ships initially, only one of which is ever used at the same time, and every time an alien eludes you, one of your ships is lost.

However, you win a bonus ship when your score exceeds 1,000 and other bonus ships when you survive six attack phases. An attack phase is eight alien ships and at the end of each attack phase the lanes are reduced in length which means you have less time to destroy the ships.

Your score for the destruction of an alien is calculated by how far along the lane the alien was — the nearer to your ship, the lower the score which can be obtained — and what attack phase you are in.

You move your ship up and down by keys Q and Z respectively with the firing of a missle by key 0. You have one missile per alien.

Great care has been taken as to the screen presentation with your spare ships indicated, plus your score and attack phase. My high score on this game was 6,060. As a piece of advice, watch out for aliens on the last lane because, for some unknown reason, they travel approximately twice as fast as any other.

```
ZX ASSAULT (1

10   LET P = 0
20   LET SC = 0
30   LET T = 3
40   POKE 16418,0
50   FOR A = 0 TO 19 STEP 3
60   FOR B = 18 TO 0 STEP -2
70   PRINT AT A,B; "■■"; AT A + 2, B; "■■"
80   NEXT B
90   PRINT AT A,26; " * "; TAB 26; " * "
100  NEXT A
110  FOR A = 1 TO (T-1) * 2 STEP 2
120  PRINT AT A, 28; "■■"
130  NEXT A
140  PRINT AT 23, 6; "■■■■■■ 0"; AT 23, 16; "■■■■■■"; SC
150  LET U = 1
160  LET X = 0
170  LET S = 10
180  LET N = -2
190  LET N = N + 2
200  FOR A = 1 TO 8
210  LET B = INT (RND * 7) * 3+1
220  FOR C = N TO 24 STEP 2
230  PRINT AT B,C; "■■"
240  IF X <> 0 THEN GOTO 510
250  IF INKEY$ = "0" THEN GOTO 490
260  PRINT AT S, 22; "  "
270  LET S = S + ((INKEY$ = "Z") *3) - ((INKEY$ = "Q")*3)
280  LET S = S + ((S = - 2) *3) - ((S = 22) *3)
290  PRINT AT B, C; "  "; AT S, 22; "■■"
300  NEXT C
310  PRINT AT U, 28; "  "
320  LET U = U + 2
330  LET T = T - 1
340  IF T = 0 THEN GOTO 700
350  NEXT A
360  FOR A = 0 TO 21
370  PRINT AT A, N; "  "
380  NEXT A
385  PRINT AT 23, 12; N/2
390  IF N<> 12 THEN GOTO 190
395  POKE 16418,2
400  CLS
410  PRINT AT 10, 0; "WELL DONE, ATTACK WAVE DEFEATED "
420  PRINT "YOU GET A BONUS SHIP"
430  PRINT, , "HIT A KEY TO CONTINUE"
440  IF INKEY$ ="" THEN GOTO 440
450  CLS
460  LET T = T + 1
470  POKE 16418, 0
480  GOTO 40
490  LET X = 22
500  LET S1 = S
510  PRINT AT S1, X; " "
520  LET X = X - 2
530  IF X = N THEN GOTO 680
540  IF (X = C OR X + 2 = C) AND S1 = B THEN GOTO 570
550  PRINT AT S1, X; " - "
560  GOTO 260
570  LET X = 0
580  PRINT AT S1, C; "   "
590  LET SC = SC + (N/2) * 10 + (20 - C)
600  PRINT AT 23, 22; SC
610  IF SC > 1000 AND P = 0 THEN GOTO 640
630  GOTO 350
640  POKE 16418,2
645  CLS
650  PRINT AT 10, 0; "WELL DONE, YOUR SCORE WAS > 1000"
660  LET P = 1
670  GOTO 420
680  LET X = 0
690  GOTO 260
700  PRINT AT 10, 5; "ANOTHER GO?"
710  POKE 16418,2
720  IF INKEY$ = "Y" THEN GOTO 750
730  IF INKEY$ = "N" THEN STOP
740  GOTO 720
750  CLS
760  RUN
```

Pascal triangle

M R Tolun,
Canterbury,
Kent.

ZX-81

PASCAL TRIANGLE evaluates and prints several rows of the well-known Pascal triangle. As a reminder to those who are not familiar with mathematical expansions, Pascal triangle is simply formed of the coefficients of the binomial expansion — that is, $(1+x)^n$ where n=0,1,2,etc.

The triangle has a number of interesting properties. First, it is symmetrical with respect to its bisector. In other words, if you cut along the central column, triangles on the left- and right-hand sides contain the same terms. Secondly, the sum of the squares of the terms of any line is always equal to a number present in the triangle. Thirdly, the sum of the numbers in the nth Pascal line is equal to 2^n.

When the program is run it produces a numerical table, triangular in shape, in which the sides are formed of unities. Any other number is generated as the sum of two numbers in the row above which are positioned at the left- and right-hand sides with respect to that number and this procedure is repeated for every pair of numbers on the same line.

One advantage of the Pascal triangle is that it can readily be employed in generating a polynomial of nth order without actually

(continued on next page)

(continued from previous page)
becoming involved in the difficulty of multiplying the appropriate coefficients. It is also worthwhile pointing out that these coefficients are formed according to the addition method described and hence the complexity of numerous multiplications is avoided.

Run the program and you can observe these properties. For a 1K machine the number of rows should not exceed eight. With the expanded memory, it is not advisable to go beyond 54 rows.

```
PASCAL TRIANGLE

10  LET N=9
20  DIM P(N,N)
30  FOR I=1 TO N
40  FOR J=1 TO I
50  IF J=1 OR J=I THEN GOTO 80
60  LET P(I,J)=P(I-1,J-1) + P(I-1,J)
70  GOTO 90
80  LET P(I,J)=1
90  NEXT J
100 NEXT I
110 PRINT "PASCAL TRIANGLE:-"
120 PRINT
130 FOR I=1 TO N
140 IF I=6 THEN GOTO 170
150 PRINT TAB 14-I;
160 GOTO 180
170 PRINT AT I+2;14-I;
180 FOR J=1 TO I
190 PRINT P(I,J);" ";
200 NEXT J
210 NEXT I
220 STOP
```

Memory table

Gwyneth Pettit,
Otley,
West Yorkshire.

BBC

THOSE WHO HAVE received their BBC Micro may find the lack of explicit machine-code facilities a hindrance in developing machine-code routines. This program will tabulate an area of memory, giving addresses and contents in hexadecimal, which is also useful for eavesdropping on the Basic interpreter and the machine-operating system. If decimal output is required, the symbol ~ can be deleted from lines containing the Print statements.

```
 10 INPUT "Start address "S%
 20 INPUT "Finish address "F%
 30 @%=&020004
 40 PRINT '"Hex""'"Address"
 50 IF S%MOD8<>0 PRINT '~S%" ";
 60 REPEAT
 70    IF S%MOD8=0 PRINT'~S%" ";
 80    PRINT~?S%;
 90    S%=S%+1
100    UNTIL S%>F%
110 PRINT
120 END
```

The symbol ' may be unfamiliar to Basic users — it forces output of a carriage return in BBC Basic; & prefixes a hexadecimal constant, @% controls output format and ~ forces hexadecimal format in printing. The ? in line 80 is the BBC equivalent of Peek. For the purist, no check is made on F% being larger than S% on input, but our working version, which includes hexadecimal input, hexadecimal options and full error checking, is rather long.

```
>RUN
Start address 3584
Finish address 3781
E00     D   0   A  1A  20  E8  22  53
E08    74  61  72  74  20  61  64  64
E10    72  65  73  73  20  22  53  25
E18    20  20   D   0  14  1A  20  E8
E20    20  22  46  69  6E  69  73  68
E28    20  61  64  64  72  65  73  73
E30    20  22  46  25   D   0  1E   F
E38    20  40  25  3D  26  30  32  30
E40    30  30  34   D   0  28  17  20
E48    F1  20  27  22  48  65  78  22
E50    27  22  41  64  64  72  65  73
E58    73  22   D   0  32  19  20  E7
E60    20  53  25  83  38  3C  3E  30
E68    20  F1  27  7E  53  25  22  20
E70    20  22  3B   D   0  3C   6  20
E78    F5   D   0  46  18  20  E7  20
E80    53  25  83  38  3D  30  20  F1
E88    27  7E  53  25  22  20  20  22
E90    3B   D   0  50   E  20  20  20
E98    20  F1  7E  3F  53  25  3B   D
EA0     0  5A   C  20  53  25  3D  53
EA8    25  2B  31   D   0  64   C  20
EB0    FD  20  53  25  3E  46  25   D
EB8     0  6E   6  20  F1   D   0  78
EC0     6  20  E0   D  FF  20
This is a tabulation of the program given above.
From this it is possible to work out the way the
B.B.C. BASIC interpreter works.
```

Organic tunes

G N Owen,
Leamington Spa,
Warwickshire.

ZX-81

THIS PROGRAM for the ZX-81 enables the computer to function as an electronic organ. The sound produced can be heard using your cassette recorder's monitor facility or by turning the TV's volume up and tuning it slightly off the normal setting.

When Run pressing 1 sounds the highest note and Y the lowest, although this can be easily extended by adding lines 1700 onwards and the appropriate lines 9041 to 9088. This program occupies less than 2K.

Try this example tune

5-5-7-6-5--6---7---8-8-9-8-7-9--

where the gap between each note represents the duration of the note.

```
100 SLOW
110 FAST
190 IF INKEY$<>"1" THEN GOTO 9000
191 GOTO 100
200 SLOW
210 FAST
290 IF INKEY$<>"2" THEN GOTO 9000
291 GOTO 200
300 SLOW
310 FAST
390 IF INKEY$<>"3" THEN GOTO 9000
391 GOTO 300
400 SLOW
410 FAST
```

```
490  IF INKEY$<>"4" THEN GOTO 9000
491  GOTO 400
500  SLOW
510  FAST
590  IF INKEY$<>"5" THEN GOTO 9000
591  GOTO 500
600  SLOW
610  FAST
690  IF INKEY$<>"6" THEN GOTO 9000
691  GOTO 600
700  SLOW
710  FAST
790  IF INKEY$<>"7" THEN GOTO 9000
791  GOTO 700
800  SLOW
810  FAST
890  IF INKEY$<>"8" THEN GOTO 9000
891  GOTO 800
900  SLOW
910  FAST
990  IF INKEY$<>"9" THEN GOTO 9000
991■ GOTO 900
1000 SLOW
1010 FAST
1090 IF INKEY$<>"0" THEN GOTO 9000
1092 GOTO 1000
1100 SLOW
1110 FAST
1190 IF INKEY$<>"Q" THEN GOTO 9000
1191 GOTO 1100
1200 SLOW
1210 FAST
1290 IF INKEY$<>"W" THEN GOTO 9000
1291 GOTO 1200
1300 SLOW
1310 FAST
1390 IF INKEY$<>"E" THEN GOTO 9000
1391 GOTO 1300
1400 SLOW
1410 FAST
1490 IF INKEY$<>"R" THEN GOTO 9000
1491 GOTO 1400
1500 SLOW
1510 FAST
1590 IF INKEY$<>"T" THEN GOTO 9000
1591 GOTO 1500
1600 SLOW
1610 FAST
1690 IF INKEY$<>"Y" THEN GOTO 9000
1691 GOTO 1600
9000 LET I$=INKEY$
9010 IF I$="" THEN GOTO 9000
9020 LET V=1*(I$="1")+2*(I$="2")
+3*(I$="3") +4*(I$="4")+5*(I$="5")
+6*(I$="6")+7*(I$="7")
9030 LET V=V+8*(I$="8") +9*(I$="9")
+10*(I$="0")+11*(I$="Q")+12*(I$="W")
9040 LET V=V+13*(I$="E")+14*(I$="R")
+15*(I$="T")+16*(I$="Y")
9089 IF V=0 THEN GOTO 9000
9090 GOTO 100*V
```

Deep-space attack

James Holland, Stockport, Cheshire.

MZ-80K

SPACE ATTACK will run on a Sharp MZ-80K. The instructions are contained in the program. The Print "C" in lines 2, 16, 43 and 50 is the clear-screen character. Usr(62) makes a beep noise. The enemy is printed on the screen in the following manner: ■■▬.

Lines 1 to 14 print the instructions.

Lines 15 to 23 set up the variables and print the gun and enemy on the screen.

Lines 24 to 32 wait for instructions from you and move the gun up and down.

Lines 33 to 36 count how many of the enemy have passed you and position the enemy randomly on the screen.

Line 37 produces a space-invader noise.

Lines 38 to 42 calculate if you have hit the enemy — if you have, it blots it out — and adds it to your score.

Lines 43 to 50 tell you how many of the enemy you have destroyed and asks you whether you want another go.

Here are some useful Pokes for the MZ-80K. Poke 6637,80 disables the Break key and Poke 6637,30 re-enables it. Poke 10680,1 makes a program unlistable and unsaveable. This can be cancelled by Poke 10680,0. Poke 59555,0 will blank the screen; Poke 59555,1 will restore the video. Programs will run automatically if, before saving, you enter Poke 10682,1.

```
SPACE ATTACK

1  REM COPYRIGHT ***JAMES HOLLAND***(14)***
2  PRINT "C"
3  PRINT" (14 SPACES)  SPACE ATTACK"
4  PRINT" (14 SPACES)              "
5  PRINT:PRINT:PRINT"The object of the game is to destroy as"
6  PRINT:PRINT"many of the attacking fleet as you can"
7  PRINT:PRINT"before five escape your fire."
      8  PRINT:PRINT"KEY:"
9  PRINT" (8 SPACES) D=go up (7 SPACES) Your gun=<"
10 PRINT:PRINT" (8 SPACES) A=go down"
11 PRINT:PRINT" (8 SPACES) S=Fire your gun (3 SPACES) The enemy =■■▬"
12 PRINT:PRINT:PRINT:PRINT:PRINT"(8 SPACES) PRESS ANY KEY TO START"
13 USR(62)
14 GET A$:IF A$ "" THEN 14
15 USR(62)
16 PRINT"C":K=0
17 POKE 10167,1:C=0
18 P=10
```

```
19 S=10
20 FOR T=2 TO 28
21 POKE 4466,S:POKE 4465,T:PRINT" ■■■ "
22 POKE 4466,P:POKE 4465,25:PRINT"<C"
23 V=0
24 GET AA$
25 IF PEEK(17828)=68 THEN V=-1
26 IF PEEK(17828)=65 THEN V=1
27 IF AA$="S" THEN 37
28 POKE 4466,P:POKE 4465,25:PRINT" "
29 P=P+V
30 IF P=-1 THEN P=0
31 IF P=23 THEN P=22
32 NEXT T
33 C=C+1
34 IF C=5 THEN GOTO 43
35 S=INT(20*RND(5))+1
36 GOTO 20
37 FOR TT=1 TO 15: POKE4514,TT : USR(68):NEXT TT:USR(71)
38 IF P=S THEN 40
39 GOTO 24
40 POKE 4466,S:POKE 4465,T:PRINT"(5 SPACES)"
41 K=K+1
42 GOTO 35
43 PRINT"C"
44 PRINT:PRINT:PRINT:PRINT"(5 SPACES) YOU DESTROYED";K;" OF THE ENEMY"
45 TEMPO 4:MUSIC"#B1A1R4A1#A1-C-AR1-A3-F3R5"
46 PRINT:PRINT:PRINT:PRINT"WOULD YOU LIKE ANOTHER GAME ?"
47 GET Q$:IF Q$="Y" THEN CLR:GOTO 12
48 IF Q$="N" THEN 50
49 GOTO 47
50 PRINT"C":END
```

Reading speed

Iain Weeks,
Prescot,
Merseyside.

MICROTAN

THE PROGRAM, which is for a Microtan 65, is a subroutine to add to a main program that uses a large list of instructions — for example, adventure-type games. The idea is to display the instructions slowly on the screen at normal reading speed.

The routine will function in its own right so it is possible to see how it operates before fitting it to a game. The routine can easily be added to any program that uses instructions by putting those instructions in the array H$(N) where N — see line 10010 — is equal to the number of array statements used. There are 10 in the case of my sample program. The line lengths will have to be adjusted to suit computers using a different screen format.

Make sure the main program does not contain any variables H$(I) or N. If it does, change the letters in the subroutine. Lines 11 to 13 are probably already in the main program so just alter the instruction If A$ = "Y" to suit.

Data statements would have been easier but I decided not to use them for, if the main program contains Data, then reading data would require amending. The speed of the printout is controlled by Line 11030 and Print Chr$(12) is the clear-screen instruction on the Microtan.

The program could be used as a reading aid for youngsters, using a simple story and gradually increasing the speed of printout as the child becomes more proficient at reading.

```
PRINTOUT

1      REM **** PRINTOUT ****
2      REM ** BY IAIN WEEKS **
10     PRINT CHR$(12)
11     PRINT"Do you want instructions (Y/N)"
12     GET A$
13     IF A$ ="Y" THEN GOSUB 10000
14     REM CONT. MAIN PROG.
9999   END
10000  PRINT CHR$(12)
10010  N =10:DIM H$(N)
10020  H$(1) ="This is a demonstration of slow printing to make pages
of"
10030  H$(2) ="instructions more interesting and easier to read. The
speed"
10040  H$(3) ="of the display can of course be altered by adjusting
the"
10050  H$(4) ="timing loop."
10060  H$(5) ="The addition of this routine to the main program is
simply a"
10070  H$(6) ="matter of putting the instructions in a 'GOSUB' and"
10080  H$(7) ="assigning each line to a 'DIM' array, then reading each
letter"
10090  H$(8) ="of the array and printing it out slowly."
10100  H$(9) ="   Easy isn't,it"
10110  H$(10) ="  And it looks good!!"
11000  FOR I = 1 TO N
11010  FOR J = 1 TO LEN(H$(I))
11020  PRINT MID$(H$(I),J,1);
11030  FOR T = 1 TO 50:NEXT T
11040  NEXT J:PRINT"":NEXT I
11050  RETURN
```

Key to functions

C J Cattenach,
Welwyn,
Hertfordshire.

VIC-20

THE FOLLOWING TIP allows one to use the four functional keys on the right-hand side of the Vic-20. These offer a total of eight functions when used with the Shift control, yet very little information is available on their use. The users' hand-book, supplied with the machine, simply says that these four tan coloured keys may be assigned functions from within the applications that you create, but no detail is given to help the newcomer to the machine who may be trying to learn Basic for the first time.

```
10 GET A$
15 IF A$ = "" THEN 10
20 IF A$ = "f1" THEN PRINT "THE USE OF
   THESE BUTTONS IS EASY"
25 IF A$ = "f2" THEN PRINT "WHEN YOU
   KNOW HOW"
30 IF A$ = "f3" THEN PRINT "AND THE
   OTHERS"
35 IF A$ = "f4" THEN PRINT "ARE ALL
```

(continued on page 75)

(continued from page 73)

```
USED IN THIS WAY."
40 GOTO 10
45 END
```

Run and press Return. From now on, one can enter the information by pressing the function buttons, and without even having to press the Return button. Line 15 ensures that the pressing of any unassigned buttons does not have any effect.

One further tip: Not all may be aware that memory locations change as a result of inserting a 16K memory expansion cartridge. This is remedied by preceding one's program with the short section of Basic code that follows.

```
2 SC=7680 (Rem set screen for 5K or 8K)
3 CL=38400 (Rem set colour for 5K or 8K)
4 FOR I= 0 to 506
5 POKE SC + I,160 (160 is a space)
6 POKE CL + I,1 (1 colour white)
7 NEXT
```

Multiplier effect

Raymond Lloyd Vickers, Crewe.

PET

DEVELOPED ON a 32K Pet, this program is designed to teach students of economics the concept of the multiplier.

The multiplier is, at its simplest, the effect on the economy of a change in investment. For example, if £1 million is invested in new machinery, then the machinery makers receive this sum, spend some of it and save the rest. Those who benefit from the spending also spend and save their income, so that the effect of the initial investment is multiplied.

Technically, the multiplier is the reciprocal of the marginal propensity to save (MPS) which is itself defined as the proportion of any increase in income which is saved. If the MPS is 0.33 then, out of every extra £1 earned, 33p is saved, 67p spent, and the multiplier is 1/0.33 = 3. So, every £1 investment will create £3 worth of money income.

In the simple model, there is no government sector so, no taxation and no foreign trade, all investment immediately produces new output in a 1:1 ratio. There is an initial limit of £3 million of productive capacity (P) while National Income (Y) is also £3 million. The MPS (S) is 0.333 so the multiplier is 3.

The initial level of investment in the economy is £1 million. If the extra investment causes money incomes to rise above the economy's productive capacity then inflation will occur, while too little investment will cause a slump. The economic model and the program are simple, but the program works and can be used as a basis for more sophisticated programs incorporating foreign trade, investment lags, and so on.

```
SIMPLE MULTIPLIER PROGRAM

10  PRINT"SIMPLE MULTIPLIER PROGRAM"
20  PRINT"GNP IS 3 MILLION"
30  PRINT"PRODUCTION IS 3 MILLION"
40  PRINT"CAPITAL OUTPUT RATIO IS 1:1"
50  PRINT"MULTIPLIER IS 3"
60  PRINT"TRY TO ENSURE STABLE GROWTH"
61  PRINT"INPUT THE INVESTMENT YOU THINK"
62  PRINT"NECESSARY.  (MILLIONS)"
65  PRINT"YOU MUST INVEST AT LEAST $100"
70  Y=3*10↑6
80  P=3*10↑6
90  I=1*10↑6
100 S=0.333
110 INPUT A:A=A*10↑6
120 CY=(I-A)/S
130 Y1=Y-CY
140 PRINT"NEW INCOME IS";Y1
150 P=P+A
160 PRINT"NEW PRODUCTION LEVEL IS";P
180 IF Y1>P GOTO 220
190 IF Y1<P GOTO 230
200 IF Y1=P GOTO 210
210 PRINT"GOOD. STABLE GROWTH"
215 GOTO110
220 PRINT"INFLATION. DECREASE INVESTMENT"
225 GOTO110
230 PRINT"SLUMP.INCREASE INVESTMENT"
235 GOTO110
READY
```

Tape directory

S Robinson, Leeds, Kent.

ATOM

TYPE IN any program title in the list on the screen, press Newline, start the tape recorder playing and it will be loaded automatically for you.

When you run the program you first input the amount of programs you want on the list — up to 16 with line 60 removed — then enter all of those program titles. When you reach the last title, start the tape recorder recording before entering it. So, when you load Dir it will run automatically.

When you Save the programs that are in the directory on that tape, ensure that you save the correct program name.

```
DIRECTORY
1   REM  DIRECTORY
2   INPUT A
3   INPUT B
4   PRINT" TAPE DIRECTORY "
5   DIM A$(A,B)
20  FOR C=1 TO A
30  INPUT C$
40  LET A$(C)=C$
50  PRINT ,A$(C)
60  PRINT
70  NEXT C
80  PRINT" INPUT GAME "
90  SAVE "DIR "
100 INPUT H$
110 PRINT ,,,," START TAPE"
120 PAUSE 20
130 LOAD H$
```

Cypher breaker

G L Billington, Bebington, Wirral.

ZX-81

THIS SHORT program, which runs in 1K, allows you to rapidly code or decode messages. X at line 20 is the code number and shifts the ZX code value of each character. The string array at line 35 accepts the coded message. Line 60 does the coding, while ignoring spaces between words; line 65 keeps spaces, question marks, commas and all full stops as they are.

To use the program, run it, and enter a suitable value for X. To start with, try a value between -1 and -9. Type in your message, but remember it must not exceed one line of 32 characters due to the Dim statement at line 35. Press Newline and in about five seconds the coded message will appear on the screen. If you have a printer, enter 00 and Newline to escape from the program, and Copy. If not, copy the coded characters by hand. For long messages, this process may be repeated as often as required.

To decode, give X the same value but of opposite sign. If you have more memory than 1K, the program can be considerably refined. As well as increasing the size of the array, the code number X can be changed several times

(continued on page 76)

(continued from page 75)

during the encoding procedure. For example, start with X = −8, then change it to say, −4 by adding a line 58:

IF N>16 THEN LET X = −4

The basis of the code thus changes about halfway through the line, making it more uncrackable. As long as the recipient of the message knows the relevant numbers, decoding is no problem.

Try using X = 160, and you will obtain a very interesting result indeed. When using other values, check that characters are not shifted into the unused range, or you will obtain question marks which cannot be decoded.

```
10 CLS
15 PRINT "CODE NO.?"
20 INPUT X
25 CLS
30 PRINT AT 0,0;X
35 DIM C$(32)
40 INPUT A$
45 IF A$="0" THEN GOTO 10
50 IF A$="00" THEN STOP
55 FOR N=1 TO LEN A$
60 IF A$(N)<>" " THEN LET C$(N)=CHR$
   (CODE A$(N)+X)
65 IF A$(N) = " " OR A$(N) ="?"
   OR A$(N)="," OR A$(N)="." THEN
   LET C$(N)=A$(N)
70 NEXT N
75 PRINT
80 PRINT C$
85 GOTO 40
```

Contents display

Gerard Leblanc, Seraing, Belgium.

ATOM

THIS MACHINE-CODE program displays the contents of a cassette and allows you to tune the cassette recorder better. Basic programs saved on cassette can be viewed in the upper half of the screen. This display can be stopped at any time, by pressing any key except Brk, Esc, shift and Ctl. It can be restarted in the same way. Characters #00 to #1F are displayed as inverted letters.

Line 35 clears the screen and line 36 requests you to have the cassette at the ready. Press a key as for *Cat command. Line 40 reads a byte from cassette. Lines 45 to 75 convert ASCII characters to video code, put it in the right position in video memory and black out the 10 oldest bytes. Line 80 checks for the key pressed to stop or restart the display.

This program is executed by Link #2800. Another location could be used by changing line 25 and the address in Link.

```
DISPLAY ATOM

10      DIM NN(6)
15      FOR I=0 TO 6;NN(I)= -1;N. I
20      P.$21
25      FOR I=1 TO 2;P=#2800
30[
35      LDA @#0;STA #80;LDA @#0C;JSR #FFF4
36      JSR #FC38
40:NN0  JSR #FBEE
45      CMP @#20;BCS NN1;ADC @#B0;JMP NN3
50:NN1
52      CMP @#40;BCC NN3;CMP @#5F;BCS NN2
54      SEC;SBC @#40;JMP NN3
60:NN2  CMP @#E0;BCS NN3;ADC @#20
65:NN3  LDX #80;STA #8000,X;INX;LDA @#C0;LDY @#0A
70:NN4  STA #8000,X;INX;DEY;BNE NN4
75      LDX #80;INX;CPX @#00;BCS NN5;LDX @#00
80:NN5  STX #80;JSR #FE71;BCS NN6;JSR #FE94
85:NN6  JMP NN0
90]
100     NEXT I;P.$6;END
```

Artful dodge

P Marco, Romford, Essex.

ZX-81

ART LETS you draw your own pictures on the TV screen. Instead of the usual four directions — up, down, left and right — this program has eight directions. Not only can you draw pictures but you can also rub them out.

The program starts in Draw mode. It can be put into Rubout mode by pressing W. It can be returned to Draw mode by pressing Q. The directions are:

- 10 to 20 Starting place of blob.
- 30 Puts blob into "Draw" mode.
- 40 Checks for mode key.
- 50 to 80 Stops blob from leaving the screen.
- 90 Moves blob left and right.
- 100 Moves blob up and down.
- 110 to 140 Moves blob diagonally.
- 150 to 160 Blinks blob.
- 170 Gives Q Draw mode and W Rubout mode.
- 180 Return to main loop.

The program will fit into 1K and a reasonable picture can be obtained. A larger and better picture can be obtained within the 16K RAM pack fitted.

If you have a 16K RAM pack, you will be able to save the picture on tape by deleting line 180 and adding these lines:

```
180 IF INKEY$ = " " THEN SAVE INKEY$
190 GOTO 40
```

The picture will be saved under the letter placed in between the inverted commas.

```
10 LET x = 28
20 LET y = 22
30 LET R$ = "Q"
40 IF INKEY$ = "Q" OR INKEY$ = "W" THEN LET R$ = INKEY$
50 IF x>= 60 THEN LET x = 60
60 IF y>= 40 THEN LET y = 40
70 IF x<= 0 THEN LET x = 0
80 IF y<= 0 THEN LET y=0
90 LET x = x + (INKEY$ = "3") - (INKEY$ = "7")
100 LET y = y - (INKEY$ = "5") + (INKEY$ = "1")
110 LET x = x + (INKEY$ = "4") - (INKEY$ = "8")
120 LET y = y - (INKEY$ = "4") + (INKEY$ = "8")
130 LET x = x + (INKEY$ = "2") - (INKEY$ = "6")
140 LET y = y + (INKEY$ = "2") - (INKEY$ = "6")
150 PLOT x,y
160 UNPLOT x,y
170 IF R$ = "Q" THEN PLOT x,y
180 GOTO 40
```

Hex convert

Paul McGowan, Atherton, Manchester.

ZX-81

MY PROGRAM will be of interest to those who have to use a hexadecimal loader. It simply converts hexadecimal into Basic. For example, if you type F5, the computer will reply:

F5 = PRINT IN BASIC

and then ask for another input. If you type a non-existent command, say, H2, the computer replies:

H2 DOES NOT EXIST IN HEX

then ask for another input to be given.

```
HEX TO BASIC

10  SCROLL
20  INPUT A$
30  IF A$=" " THEN RUN
40  IF LEN A$ = 1 THEN GOTO 100
50  LET A = ( 16 * ( CODE A$ (1) - 28 ) +
    (CODE A$ (2) - 28 ))
60  SCROLL
70  IF A> 255 OR A< 0 THEN GOTO 100
80  PRINT A$ ; " = " ; CHR$ A ; "IN BASIC"
90  GOTO 10
100 PRINT A$ ; " DOES NOT EXIST IN HEX. "
110 GOTO 10
```

Over the moon

A Cockburn,
Warrington,
Cheshire.

BBC

FOR MY VERSION of the popular Lunar Lander for a Model A, BBC Micro, first you input your fuel allowance and then your flight commences. The lander is dropping out of orbit in the top left-hand corner of the screen. You apply upward and horizontal thrust to bring it to a soft and happy landing on the base pad.

On the right-hand side of the screen you have your instruments. Alt gives the altitude in metres; V-V gives the vertical velocity or descent rate; H-V gives the horizontal velocity or drift. Fuel gives an indication of how much fuel is left; bearing indicates horizontal distance from the landing pad.

From the instruments you can tell exactly where you are even if you are off the screen and it is possible to do blind landings. When you have used three-quarters of your fuel, a warning flashes and when all fuel is used the display flashes red. Assuming you have successfully landed, the computer then passes comments on your performance.

As the program is run in Mode 4 it takes up all but 90 bytes of the user RAM. I have used multi-statement lines to the full to eliminate the need for subroutines and to save memory. Line 10, which is intended to bring the program back to the beginning when the escape key is pressed, is best omitted until the program is running correctly.

```
LUNA LANDER

10  ON ERROR RUN
20  MODE 7
30  PRINT TAB (15) "LUNA LANDER"''"PRESS 'U' FOR UPWARD THRUST"''"PRESS
'R' FOR REVERSE THRUST"''"PRESS 'F' FOR FORWARD THRUST"''''
40  INPUT"FUEL ALLOWANCE",F''
50  IF F> 500 PRINT"YOU CAN'T AFFORD THAT MUCH!"'':NOWTIME=TIME:REPEAT:
UNTIL TIME=NOWTIME+200:GOTO10
60 IF F<100 PRINT"NOT EVEN BUCK ROGERS IS THAT GOOD!"'':NOWTIME=TIME:
REPEAT:UNTIL TIME=NOWTIME+200:GOTO10
70  PRINT ''"HIT ANY KEY TO START":Z=GET
80  MODE 4
90  MOVE 0,0
100 DRAW 1280,0
110 MOVE 600,4
120 DRAW 680,4
130 FORG=0 TO 200:PLOT 69,RND(1280),RND(1024):NEXT
140 E=0:A=9770:V=0:H=27:K=F:AL=0
150 PRINTTAB (35,4)"ALT"
160 PRINTTAB (35,8)"V-V"
170 PRINTTAB (35,12)"H-V"
180 PRINTTAB (35,16)"FUEL"
190 PRINTTAB (33,20)"BEARING"
200 E=E+H:A=A-V
210 B=INT((E-640)/6.4)
220 A=A+24:GCOL 0, 1:MOVE E-20,A:MOVE E+20,A:PLOT 85,E,A+20:MOVE
E-20,A:
DRAW E-20,A-16:MOVE E+20,A:DRAW E+20,A-16:A=A-24
230 PRINTTAB (28,5)A
240 PRINTTAB (28,9)V*4
250 PRINTTAB (28,13)H
260 PRINTTAB (28,17)F
270 PRINTTAB (28,21)B
280 IF A<0 A=0:GOTO 490
290 D=H:I=V
300 IF F<3:F=0:GOTO 360
310 C$=INKEY$ (0)
320 IF C$="F" H=H+1:F=F-3
330 IF C$="R" H=H-1:F=F-3
340 IF C$="U" V=V-2:F=F-3
350 *FX 15,0
360 IF AL>2:AL=0
370 IF F<K/4 AND AL<2 PRINTTAB (34,24)"ALARM":AL=AL+1:IF F=0:VDU
19,1,1,
0,0,0:PRINT TAB (15,15)"NO FUEL"
380 IF AL>1 PRINT TAB (34,24) "       ":AL=AL+1:IF F=0:VDU 19,1,7,0,0,0
390 IF F<K/4 PRINT TAB (35,28) "FUEL" TAB (33,29) "WARNING"
400 IF D<>H OR I<>V:SOUND 0,-10,4,10
410 IF I<>V GCOL 0,1:MOVE E,A+24:DRAW E,A-30:MOVE E,A+24:DRAW E-8,A-30:
MOVE E,A+24:DRAW E+8,A-30:GCOL 0,0:MOVE E,A-30:MOVE E,A+24:DRAW
E-8,A-30:
MOVE E,A+24:DRAW E+8,A-30
420 IF D>H GCOL0,1:A=A+24:MOVE E+20,A:DRAW E+60,A:MOVE E+20,A:DRAW
E+60,A-4:
MOVE E+20,A:DRAW E+60,A+4:GCOL 0,0:MOVE E+20,A:DRAW E+60,A:MOVE E+20,A:
DRAW E+60,A-4:MOVE E+20,A:DRAW E+60,A+4:GCOL 0, 1:A=A-24
430 IF D<H GCOL0,1:A=A+24:MOVE E-20,A:DRAW E-60,A:MOVE E-20,A:DRAW
E-60,A-4:
MOVE E-20,A:DRAW E-60,A+4:GCOL 0,0:MOVE E-20,A:DRAW E-60,A:MOVE E-20,A:
DRAW E-60,A-4:MOVE E-20,A:DRAW E-60,A+4:GCOL 0,1:A=A-24
440 V=V+1
450 NOWTIME=TIME:REPEAT:UNTILTIME=NOWTIME+10
460 A=A+24:GCOL 0,0:MOVE E-20,A:MOVE E+20,A:PLOT 87,E,A+20:MOVE E-20,A:
DRAW E-20,A-16:MOVE E+20,A:DRAW E+20,A-16:A=A-24
470 IF A< 50 GCOL 0,1: MOVE 0,0:DRAW 1280,0:MOVE 600,4:DRAW 680,4
480 GOTO 150
490 VDU 30;19,1,7,0,0,0
500 IF V<5 AND K-F<300 AND ABS (B)<5: PRINT "HELLO BUCK ROGERS"''
510 IF ABS(B)<6 AND V<5 AND (K-F)>299:PRINT"GOOD BUT EXTRAVAGENT!!"''
520 IF V<5 AND H<5: PRINT"SMOOTH!"''
530 IF V>4 OR H>9:FOR A=0 TO 255 STEP 7:SOUND1, -15,A,0:NEXT:FORY=-15
TO 0:
SOUND0,Y,4,2.5:NEXT:GCOL 0,1:MOVE E,0:DRAW E-100,100:MOVE E,0:DRAW
E,100:
MOVE E,0:DRAW E+100,100:PRINT"YOU CRASHED!!!" ' GOTO 570
540 IF V<5 AND H>4 AND H<10 PRINT "BUMPY!"''
550 IF ABS(B)>3:PRINT"BUT YOU ARE ";ABS(B),"METRES FROM
BASE."''"WALK!"''
560 PRINT "YOU USED ";K-F" FUEL UNITS"''
570 PRINT '''''''''"HIT SPACE BAR TO CONTINUE":REPEAT A$=GET$:UNTILA$="
"
580 GOTO 20
```

Tunnel vision

D M Jones,
Mold,
Clwyd.

VIC-20

THE PROGRAM prints a random maze and the player takes the form of the diamond at the top of the screen. The object is to reach the circle at the bottom of the maze, without colliding with a wall, in the least number of moves.

On most mazes that the computer forms, it is impossible to reach the circle without pressing the nought key. When this key is pressed the walls immediately above, below, to the left, and right of your diamond are demolished and disappear. However, using this feature increases your number of moves by four.

When you reach the circle you are told your score and the lowest number of moves the maze has been completed in so far. The program itself is fairly basic and sound and colour could be added for the 3.5K machine.

```
   0 REM*MAZE*
  10 PRINT"□":S=100000
  20 V=0:M=0
  30 E=INT(22*RND(1)+7702)
  40 H=INT(22*RND(1)+8164)
  50 PRINT"*********@MAZE■*********"
  60 PRINT"    2:-DOWN     4:-UP"
  70 PRINT"    6:-LEFT     8:-RIGHT"
  75 PRINT"          0:-DEMOLISH"
  80 PRINT"**********************"
  90 FORU=0TO5000:NEXTU:PRINT"□"
 100 POKE36879,0
 110 FORA=1TO250
 120 B=INT(462*RND(1)+7724)
 130 POKEB,91
 140 NEXTA
 150 POKEH,81:GETA$
 160 POKEE,90
 170 IFA$="2"THENG=22:GOTO250
 180 IFA$="4"THENG=-22:GOTO250
 190 IFA$="6"THENG=-1:GOTO250
 200 IFA$="8"THENG=1:GOTO250
 210 IFA$="0"THENGOSUB1000
 220 GOTO150
 250 M=M+1
 260 POKEE,32:E=E+G
 270 IFPEEK(E)=91THEN550
 280 POKEE,90
 290 IFE=HTHEN600
 300 GOTO150
 550 POKE36879,27:PRINT"□YOU HIT A WALL"
 560 INPUT"ANOTHER GAME(Y/N)";G$
 570 IFG$="N"THENSTOP
 580 PRINT"□"
 590 GOTO20
 600 POKE36879,27:PRINT"WELL DONE!YOU MADE IT!"
 610 PRINT"IN "M" MOVES."
 620 IFM<STHENS=M
 630 PRINT"LEAST MOVES= "S
 640 GOTO560
1000 IFV<3THENGOTO1020
1010 GOTO150
1020 POKEE+1,32:POKEE-1,32
1030 POKEE+22,32:POKEE-22,32:V=V+1:M=M+4
1040 RETURN
```

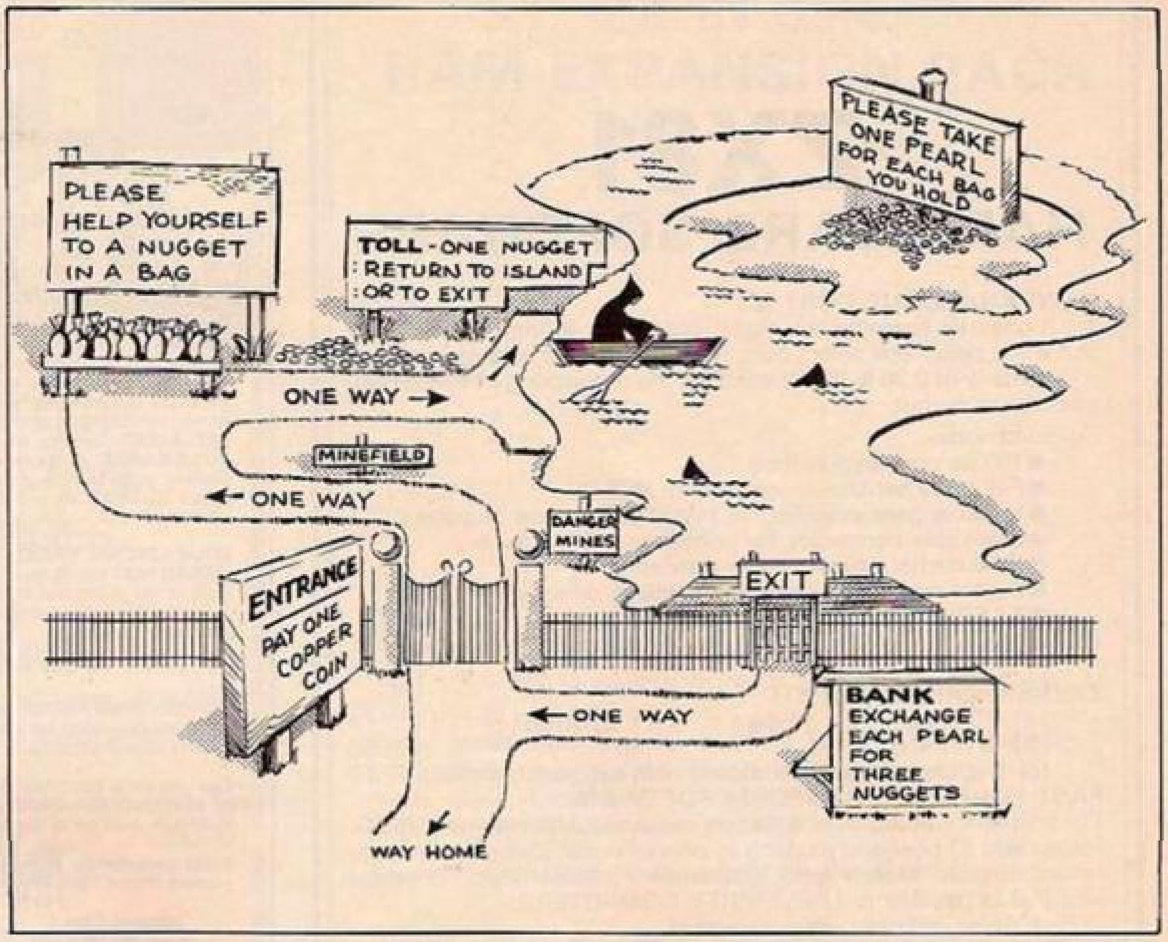
■

Golden nugget

BY ANTHONY ROBERTS

HERE IS THE PLAN of Old Swan adventure park. You pay a coin to enter, help yourself to a nugget in a bag, use it to pay the blind ferryman to ferry you to the exit, and leave. You could pay the ferryman to take you to the island and pick up a pearl — but it would do you little good as you then would not be able to leave the park. However, the Wizard One-eye has a plan: when you help yourself to a nugget in its bag substitute a stone for each nugget before you reach the ferryman who is too old and blind to notice — provided there is only one stone per bag of course. If the Wizard One-eye starts with enough copper coins to keep on re-entering the park he would finish up with a fortune, because of the steadily-increasing number of bags he would be carrying to the island — especially as the stone in each bag buys its own trip to the island — except for the final one to reach the exit on each trip.

The Wizard has arrived with a bag of coins, and leaves with the maximum number of nuggets he could obtain — curiously, 32K or 32,768. How many coins did he start with?



Competition prize winners

THERE WERE 400 entries for the Memotech 64K RAM pack competition in April. Once again, most were correct, making the task of choosing a winner difficult. After some discussion, the 64K RAM pack was awarded to N Fuller of 5 Southbourne Avenue, Emsworth, Hampshire PO10 8BB, for his "I need a 64K RAM pack because . . . absence makes the mi-cro founder".

Other notable entries included M White's "with 16K, the answer to the ultimate question comes out 4/2000" and R Whitaker's "the monsters in adventure programs need plenty of byte". B Buck of Northampton was quick off the mark with "this will open up a whole new 'spectrum' of programming possibilities" while John Mallon revealed a musical bent; "she's only 16 but I'll love her even more at 64".

Stephen Dunning echoed a number of readers' sentiments with "it drives me up the wall to see report code four" while Mark Kirkby waxed lyrical with "I wanna do decent progin' without the RAM pack wobblin' ". K Rawkins concluded "then I would be able to answer the $64,000 question" and Graham Newcombe decided "1K is K.O.'d, O.K.?". Last word on the subject went to P Blenkinsop who revealed that "playing one-roomed adventure is becoming a real bore."

The Klingon death competition also drew a large response. The problem was to find the defuse button which turned off the automatic defences which guarded the Klingons' treasure. Every button, except for the defuse button, could be pressed in a closed loop sequence where every button was identical to the previous button in three of its four symbols.

One solution was to write a program to look for the sequence and thus work out the defuse button. But the easy method was to write a program which looked for a button which did not have three symbols which were identical to two other buttons — because it cannot be part of a circular loop of buttons. The only button which fits this description lies in row 4, column 2 of the control panel:

Δ■
Δ●

The winning solution was sent in by Geof Cheyne of Kirkhouse Lodge, Traquair, Innerleithen, Peebleshire EH44 6PU. The letters in his program stand for the following symbols, A = a black circle, B = a black square, C = a black triangle and D = a white triangle.

```
KLINGON DEATH  -  ZX81

10  DIM A$(64,4)
15  FOR X=1 TO 64
20  INPUT A$(X)
25  NEXT X
100 FOR X=1 TO 64
105 LET B$=A$(X,1 TO 3)
110 LET C$=A$ (X,2 TO )
115 LET D$=A$(X,1)+A$(X,3 TO )
120 LET E$=A$(X,1 TO 2)+A$(X,4)
125 LET C=0
130 FOR Y=1 TO 64
135 IF (Y<>X AND B$=A$(Y,1 TO 3))
    OR (Y<>X AND C$=A$(Y,2 TO  ))
    OR (Y<>X AND D$=A$(Y,1)+A$(Y,3 TO ))
    OR (Y<>X AND E$=A$(Y,1 TO 2)+A$(Y,4))
    THEN LET C=C+1
140 NEXT Y
145 IF NOT C>1 THEN PRINT A$(X)
150 NEXT X
```

Solution to the April crossword.



ZX81

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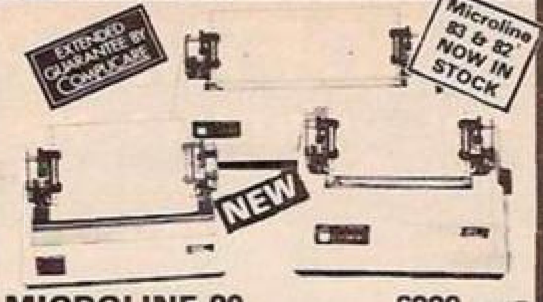


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48K £649 + VAT

Getting Started APPLE II is faster, smaller, and more powerful than its predecessors. And it's more fun to use too because of built-in features like:
● BASIC — The Language that Makes Programming Fun. ● High-Resolution Graphics (in a 54,000-Point Array) for Finely-Detailed Displays. ● Sound Capability that Brings Programs to Life. ● Hand Controls for Games and Other Human-Input Applications. ● Internal Memory Capacity of 48K Bytes of RAM, 12K Bytes of ROM; for Big System Performance in a Small Package. ● Eight Accessory Expansion Slots to let the System Grow With Your Needs.

You don't need to be an expert to enjoy APPLE II. It is a complete, ready-to-run computer. Just connect it to a video display and start using programs (or writing your own) the first day. You'll find that its tutorial manuals help you make it your own personal problem solver.

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- 80/132 Column
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ZX80

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ZX81

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GAMES PACK – ***Beat this for value! 5 × 16K programs PLUS 2 × 1K programs*** **£4.95 ($9.90)**

3-D Battle (M/code-1K) – Fast moving space battle with continuous count down of energy units left.

City Bomb (M/code-1K) – Destroy the buildings and land your plane. Your fuel has nearly gone and you circle the city lower and lower

Warp Wars (Basic & M/code-16K) – Features realistic space craft moved by M code for instant response (previously sold at Microfair with Sweet Tooth for £4.95)

Snake (Basic-16K) – A game of thought and skill. Pass through all the marked squares without crossing or doubling back on your path but watch out for the expanding black blob (previously sold at Microfair for £3.95)

Sweet Tooth (Basic & M/code-16K) – M code routines used to move your fat face round the screen and gobble the sweets

PLUS Slalom and Black Holes (previously sold together for £4.95)

An ESSENTIAL addition to your 1K RAM ZX81 (or ZX80 8K ROM)
(please state which when ordering)

TOOLKIT (written by PAUL HOLMES)

Provides the following additional facilities

Line renumber   you state starting number and increment value
Search and replace   changes every occurence of a character as you require
Free space   tells you how many free bytes you have left

SPECIAL GRAPHICS ROUTINES

Hyper graphics mode   graphics never seen on a ZX81 before.
Open   instantly sets up as many empty print lines as you require. (1K version only)
Fill   used in conjunction with OPEN fills your screen instantly with your specified character
Reverse   changes each character on your screen to its inverse video.

TAPE ROUTINE   provides a system **WAIT** condition until a signal is received in the cassette ear jack   many uses !

All these routines are written in machine code and together take up only 164 BYTES of your precious RAM   an incredible achievement!!

The price is incredible too! ONLY **£3.95 ($7.90)** for cassette, including FULL instructions and example programs.

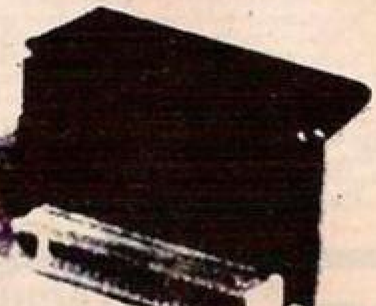
ALSO available 16K version ONLY **£4.95 ($9.90)** which includes all the above PLUS GOTO's and GOSUB's included in line renumber.
Search for and list every line containing specified character.

16K VERSION

As reviewed in *'YOUR COMPUTER'* March 1982

16K RAM PACK
£35 ($69.95)

WHY PAY MORE



Fully built, tested and guaranteed. No additional power supply required, black case

No wobble problems – fully compatible with printer etc, etc

(Please send large S.A.E. + 50p for a copy of *'YOUR COMPUTER'* RAM pack reviews (March 1982) – Refunded when you purchase the RAM pack). Please allow 21 days for delivery

STOP PRESS

NOW AVAILABLE – 64K RAM pack (56K useable) **£75** inclusive

NEW **GRAPHICS TOOLKIT** (Another masterpiece by PAUL HOLMES)

22 exciting MACHINE CODE routines that give you control over your screen as never before !

(ZX81 - 16K RAM ONLY)

DRAW/UNDRAW draws or deletes your multi-character shape which is defined in a REM statement. You may define as many different shapes as you like and draw or undraw each at will at whichever screen position you choose

FOREGROUND ON/OFF use this to 'protect' existing characters on your screen. When on new shapes will appear to slide behind and re-emerge from other shapes

BORDER/UNBORDER Draws a border round the edges of your screen area. Edit lines can be used if required. Your border is protected when foreground is on

FILL Fills any number of lines you specify, starting at any line you specify, by your chosen character

REVERSE Converts all characters to their inverse video, control as in FILL

PRINT POSITION CONTROLS
UP, DOWN, LEFT, RIGHT – After your next PRINT position in the direction indicated

EDITPRINT Moves next PRINT position to first edit line

SCROLL facilities
UPSCROLL, DOWNSCROLL, RIGHTSCROLL, LEFTSCROLL – Scroll your screen in the direction indicated

ONSCREEN/OFFSCREEN turns your screen on or off

BACKGROUND ON/OFF
Fills your screen by your specified character. When foreground is on existing information is unaffected and shapes will appear to pass in front of your background, without deleting it

SEARCH AND REPLACE will search the screen for every occurence of the character you specify and replace it with your new character

SQUARE draws a square or rectangle from your specified co-ordinates

ALL these routines are in machine code for SUPER-FAST response ! Simply load GRAPHICS TOOLKIT, which repositions itself at the end of your RAM, and then your own program (or key in a new one), GRAPHICS TOOLKIT uses only 2K of your RAM and that includes space to load the programmers TOOLKIT described above (16K RAM version)

ALL FOR ONLY £5.95 ($11.90)
(amazing value from JRS)

This includes a cassette with 2 copies of the program plus a comprehensive instruction booklet with examples

NOTE: All prices are fully inclusive – send cheque or P.O. to JRS Software at above address

OVERSEAS CUSTOMERS PLEASE NOTE Payment may be made in Sterling (Money Order available at your bank) ou $U.S. (U.S.A. customers only).

Prices quoted above are also export prices and include AIRMAIL postage

When you outgrow your personal computer that's the time you'll wish you'd bought a DAI.

Very low priced personal computers can leave you feeling very low, after the initial novelty has worn off. Having learned what the computer can do, you then find out what it can't do. Unless you expand the system. And that can set you back a few hundred pounds for items such as extra RAM and serial interface. In fact, more than you paid in the first place!
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Sinclair ZX81 Personal Com[p
the heart of a system that grows with you.



1980 saw a genuine breakthrough – the Sinclair ZX80, world's first complete personal computer for under £100. Not surprisingly, over 50,000 were sold.

In March 1981, the Sinclair lead increased dramatically. For just £69.95 the Sinclair ZX81 offers even more advanced facilities at an even lower price. Initially, even we were surprised by the demand – over 50,000 in the first 3 months!

Today, the Sinclair ZX81 is the heart of a computer system. You can add 16-times more memory with the ZX RAM pack. The ZX Printer offers an unbeatable combination of performance and price. And the ZX Software library is growing every day.

Lower price: higher capability
With the ZX81, it's still very simple to teach yourself computing, but the ZX81 packs even greater working capability than the ZX80.

It uses the same micro-processor, but incorporates a new, more powerful 8K BASIC ROM – the 'trained intelligence' of the computer. This chip works in decimals, handles logs and trig, allows you to plot graphs, and builds up animated displays.

And the ZX81 incorporates other operation refinements – the facility to load and save named programs on cassette, for example, *and* to drive the new ZX Printer.



New BASIC manual

Every ZX81 comes with a comprehensive, specially-written manual – a complete course in BASIC programming, from first principles to complex programs.

Kit: £49.95

Higher specification, lower price – how's it done?
Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

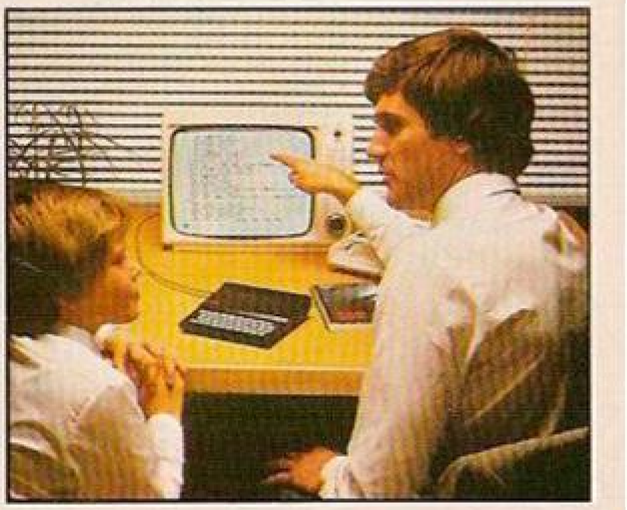
The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

New, improved specification
- Z80A micro-processor – new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique syntax-check and report codes identify programming errors immediately.
- Full range of mathematical and scientific functions accurate to eight decimal places.
- Graph-drawing and animated-display facilities.
- Multi-dimensional string and numerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function – useful for games as well as serious applications.
- Cassette LOAD and SAVE with named programs.
- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer.
- Advanced 4-chip design: micro processor, ROM, RAM, plus master chip – unique, custom-built chip replacing 18 ZX80 chips.

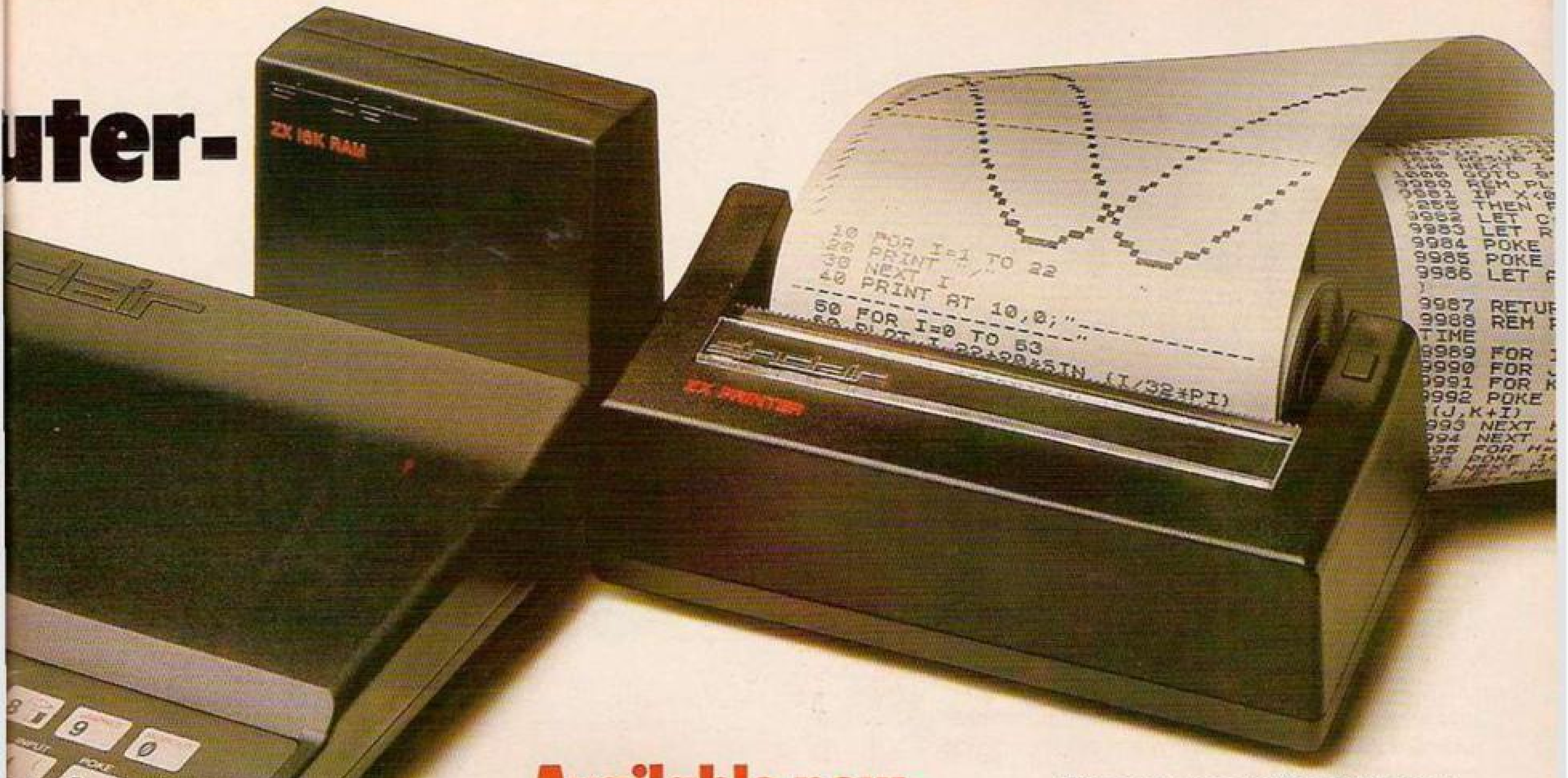
Built: £69.95

Kit or built – it's up to you!
You'll be surprised how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 700 mA at 9 V DC nominal unregulated (supplied with built version).

Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.



uter-



Available now- the ZX Printer for only £59.95

Designed exclusively for use with the ZX81 (and ZX80 with 8K BASIC ROM), the printer offers full alphanumerics *and* highly sophisticated graphics.

A special feature is COPY, which prints out exactly what is on the the whole TV screen without the need for further intructions.

At last you can have a hard copy of your program listings – particularly useful when writing or editing programs.

And of course you can print out your results for permanent records or sending to a friend.

Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your computer – using a stackable connector so you *can* plug in a RAM pack as well. A roll of paper (65 ft long x 4 in wide) is supplied, along with full instructions.

16K-byte RAM pack for massive add-on memory.

Designed as a complete module to fit your Sinclair ZX80 or ZX81, the RAM pack simply plugs into the existing expansion port at the rear of the computer to multiply your data/program storage by 16!

Use it for long and complex programs or as a personal database. Yet it costs as little as half the price of competitive additional memory.

With the RAM pack, you can also run some of the more sophisticated ZX Software – the Business & Household management systems for example.

How to order your ZX81

BY PHONE – Access, Barclaycard or Trustcard holders can call 01-200 0200 for personal attention 24 hours a day, every day.

BY FREEPOST – use the no-stamp-needed coupon below. You can pay by cheque, postal order, Access, Barclaycard or Trustcard.

EITHER WAY – please allow up to 28 days for delivery. And there's a 14-day money-back option. We want you to be satisfied beyond doubt – and we have no doubt that you will be.

To: Sinclair Research, FREEPOST, Camberley, Surrey, GU15 3BR. **Order**

Qty	Item	Code	Item price £	Total £
	Sinclair ZX81 Personal Computer kit(s). Price includes ZX81 BASIC manual, excludes mains adaptor.	12	49.95	
	Ready-assembled Sinclair ZX81 Personal Computer(s). Price includes ZX81 BASIC manual and mains adaptor.	11	69.95	
	Mains Adaptor(s) (700 mA at 9V DC nominal unregulated).	10	8.95	
	16K-BYTE RAM pack.	18	29.95	
	Sinclair ZX Printer.	27	59.95	
	8K BASIC ROM to fit ZX80.	17	19.95	
	Post and Packing.			2.95

☐ Please tick if you require a VAT receipt TOTAL £______

*I enclose a cheque/postal order payable to Sinclair Research Ltd, for £______

*Please charge to my Access/Barclaycard/Trustcard account no.

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Name: Mr/Mrs/Miss

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FREEPOST – no stamp needed. YOC 06

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ZX81

6 Kings Parade, Cambridge, Cambs., CB2 1SN. Tel: (0276) 66104 & 21282.

Make the most of your Sinclair ZX Computer...

Sinclair ZX software on cassette.

£3.95 per cassette.



The unprecedented popularity of the ZX Series of Sinclair Personal Computers has generated a large volume of programs written by users.

Sinclair has undertaken to publish the most elegant of these on pre-recorded cassettes. Each program is carefully vetted for interest and quality, and then grouped with other programs to form a single-subject cassette.

Each cassette costs £3.95 (including VAT and p&p) and comes complete with full instructions.

Although primarily designed for the Sinclair ZX81, many of the cassettes are suitable for running on a Sinclair ZX80 – if fitted with a replacement 8K BASIC ROM.

Some of the more elaborate programs can be run only on a Sinclair ZX Personal Computer augmented by a 16K-byte add-on RAM pack.

This RAM pack is described below. And the description of each cassette makes it clear what hardware is required.

16K-BYTE RAM pack

The 16K-byte RAM pack provides 16-times more memory in one complete module. Compatible with the ZX81 *and* the ZX80, it can be used for program storage or as a database.

The RAM pack simply plugs into the existing expansion port on the rear of a Sinclair ZX Personal Computer.

Cassette 1 – Games

For ZX81 (and ZX80 with 8K BASIC ROM)

ORBIT – your space craft's mission is to pick up a very valuable cargo that's in orbit around a star.

SNIPER – you're surrounded by 40 of the enemy. How quickly can you spot and shoot them when they appear?

METEORS – your starship is cruising through space when you meet a meteor storm. How long can you dodge the deadly danger?

LIFE – J. H. Conway's 'Game of Life' has achieved tremendous popularity in the computing world. Study the life, death and evolution patterns of cells.

WOLFPACK – your naval destroyer is on a submarine hunt. The depth charges are armed, but must be fired with precision.

GOLF – what's your handicap? It's a tricky course but you control the strength of your shots.

Cassette 2 – Junior

For ZX81 with 16K RAM pack

CRASH – simple addition – with the added attraction of a car crash if you get it wrong.

MULTIPLY – long multiplication with five levels of difficulty. If the answer's wrong – the solution is explained.

TRAIN – multiplication tests against the computer. The winner's train reaches the station first.

FRACTIONS – fractions explained at three levels of difficulty. A ten-question test completes the program.

ADDSUB – addition and subtraction with three levels of difficulty. Again, wrong answers are followed by an explanation.

DIVISION – with five levels of difficulty. Mistakes are explained graphically, and a running score is displayed.

SPELLING – up to 500 words over five levels of difficulty. You can even change the words yourself.

Cassette 3 – Business and Household

For ZX81 (and ZX80 with 8K BASIC ROM) with 16K RAM pack

TELEPHONE – set up your own computerised telephone directory and address book. Changes, additions and deletions of up to 50 entries are easy.

NOTE PAD – a powerful, easy-to-run system for storing and retrieving everyday information. Use it as a diary, a catalogue, a reminder system, or a directory.

BANK ACCOUNT – a sophisticated financial recording system with comprehensive documentation. Use it at home to keep track of 'where the money goes,' and at work for expenses, departmental budgets, etc.

Cassette 4 – Games

For ZX81 (and ZX80 with 8K BASIC ROM) and 16K RAM pack

LUNAR LANDING – bring the lunar module down from orbit to a soft landing. You control attitude and orbital direction – but watch the fuel gauge! The screen displays your flight status – digitally and graphically.

TWENTYONE – a dice version of Blackjack.

COMBAT – you're on a suicide space mission. You have only 12 missiles but the aliens have unlimited strength. Can you take 12 of them with you?

SUBSTRIKE – on patrol, your frigate detects a pack of 10 enemy subs. Can you depth-charge them before they torpedo you?

CODEBREAKER – the computer thinks of a 4-digit number which you have to guess in up to 10 tries. The logical approach is best!

MAYDAY – in answer to a distress call, you've narrowed down the search area to 343 cubic kilometers of deep space. Can you find the astronaut before his life-support system fails in 10 hours time?

Cassette 5 – Junior Education: 9-11-year-olds

For ZX81 (and ZX80 with 8K BASIC ROM)

MATHS – tests arithmetic with three levels of difficulty, and gives your score out of 10.

BALANCE – tests understanding of levers/fulcrum theory with a series of graphic examples.

VOLUMES – 'yes' or 'no' answers from the computer to a series of cube volume calculations.

AVERAGES – what's the average height of your class? The average shoe size of your family? The average pocket money of your friends? The computer plots a bar chart, and distinguishes MEAN from MEDIAN.

BASES – convert from decimal (base 10) to other bases of your choice in the range 2 to 9.

TEMP – Volumes, temperatures – and their combinations.

Cassette 6 – Family Quiz

For ZX81 (and ZX80 with 8K BASIC ROM) with 16K RAM pack.

Four different quizzes, each consisting of 10 questions suitable for the whole family. There's a target time for each quiz, and at the end you're told how long you took to answer the questions – and how many you got right. The quizzes cover a range of topics – including maths, English grammar, and general knowledge.

How to order

Simply use the order form below, and either enclose a cheque or give us the number of your Access, Barclaycard or Trustcard account. Please allow 28 days for delivery. 14-day money-back option.

sinclair ZX SOFTWARE

Sinclair Research Ltd, 6 Kings Parade, Cambridge, Cambs., CB2 1SN. Tel: 0276 66104.

To: Sinclair Research FREEPOST, Camberley, Surrey. GU15 3BR.

Please send me the items I have indicated below. *Please print*

Qty	Code	Item	Item price	Total
	21	Cassette 1 – Games	£3.95	
	22	Cassette 2 – Junior Education	£3.95	
	23	Cassette 3 – Business and Household	£3.95	
	24	Cassette 4 – Games	£3.95	
	25	Cassette 5 – Junior Education	£3.95	
	26	Cassette 6 – Family Quiz	£3.95	
	17	*8K BASIC ROM for ZX80	£19.95	
	18	*16K RAM pack for ZX81 and ZX80	£29.95	
		*Post and packing (if applicable)	£2.95	
			Total £	

*Please add £2.95 to total order value only if ordering ROM and/or RAM.

I enclose a cheque/PO to Sinclair Research Ltd for £________

Please charge by Access*/Barclaycard/Trustcard no.

**Please delete as applicable.*

Name: Mr/Mrs/Miss

Address:

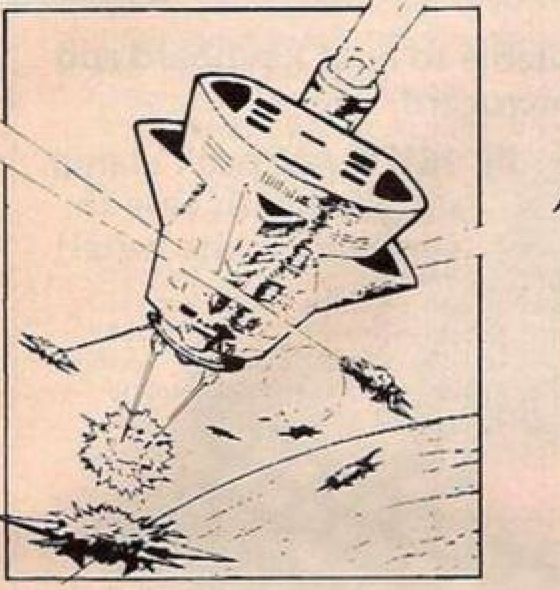
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ZX-81

ZX-80



QS DEFENDER.
UP – DOWN – THRUST – FIRE
First and only full screen display. Software to drive QS SOUND BD. Moving Planetary surface. Up to 84 fast moving characters on screen at once. On screen scoring. Ten missiles at once. Increasing attack patterns. Requires 8K ROM, and 4K min of RAM. **£5.50.**

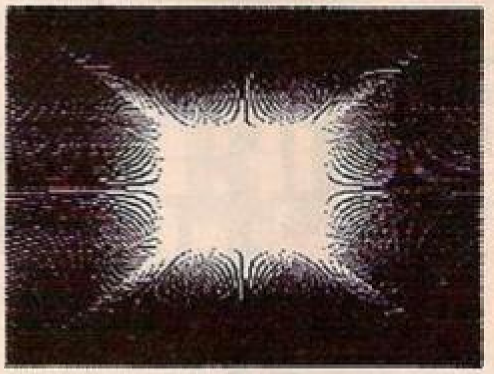
QS SOUND BD.
A programmable sound effects board using the AY-3-8910. 3 TONES; 1 NOISE; ENVELOPE SHAPER: + TWO 8 BIT I/O PORTS. Easily programmable from BASIC, the AY chip does most of the work leaving your computer free for other things. Signal O/P via 3.5 mm Jack socket Ports O/P via a 16 pin I.C. Socket. **£26.00.**

QS CHRS BD./
A programmable character generator giving – 128 SEPARATELY PROGRAMMABLE CHARACTERS. ON/OFF SWITCH. 1K ON BOARD RAM. Enables creation and display of your own characters to screen or printer. Demo cassette of fast machine code operation routines and lower case alphabet included. See below for ZX PRINTER listing. **£26.00.**

QS - LOWER CASE
abcdefghijklmnopqrstuvwxyz



QS INVADERS.
LEFT – RIGHT – FIRE
13×7 INVADERS; High score; 3 levels of play; RND saucers; Bonus base; Drives Sound bd. & CHRS bd. Requires 7K RAM, 8K ROM + Slow. **£5.50.**



QS HI-RES BD.
A Hi-res graphics board giving – 256×192 PIXELS. 6K ON BD. RAM. SOFTWARE SELECT/DESELECT. MIXED TEXT AND GRAPHICS. 2K ON BOARD ROM. Resident fast machine code graphics software (in ROM) provides the following HI-RES Commands. – MOVE x, y; PLOT x, y; DRAW x, y; BOX x, y; UP; DOWN; LEFT; RIGHT; PRINT A$; SCROLL; BLACK; WHITE CLEAR COPY. See above for ZX PRINTER listings using COPY. **£85.00.**



QS ASTEROIDS.
LEFT – RIGHT – THRUST – FIRE
Software to drive QS SOUND BD. Multiple missiles firing in 8 directions. On screen scoring. Increasing number of asteroids. Full mobility of ship to all areas of the screen. Two asteroid sizes. Bonus ship at 10,000 points. Requires 8K ROM, 4K min of RAM + SLOW function. **£5.50.**

QS 3K RAM Bd.
An extremely reliable static RAM Bd. which combines with the computer's memory to give 4K total. Plugs direct in to the rear port on your ZX Computer. **£15.00.**

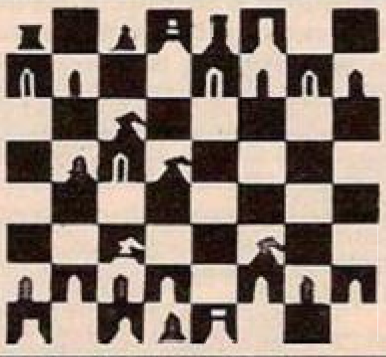
QS MOTHER BOARD BD. & QS CONNECTOR.
A reliable expansion system allowing a total of any RAM pack plus two other plug in boards to be in use at once. On board 5V regulator drives all external boards. Fitted with two 23 way double sided edge connectors. Connector is 2×23 way edge conns soldered back to back. Expansion can operate in two ways – (1) COMPUTER ↔ CONNECTOR ↔ Any QS add on bd. (but no extra RAM pack). (2) COMPUTER ↔ CONNECTOR ↔ MOTHER BD ↔ ANY RAM PACK. (2 bds to fit in mother bd.) Mother board **£12.00** Connector **£4.00.**

Special offers & news

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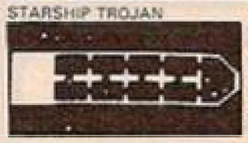
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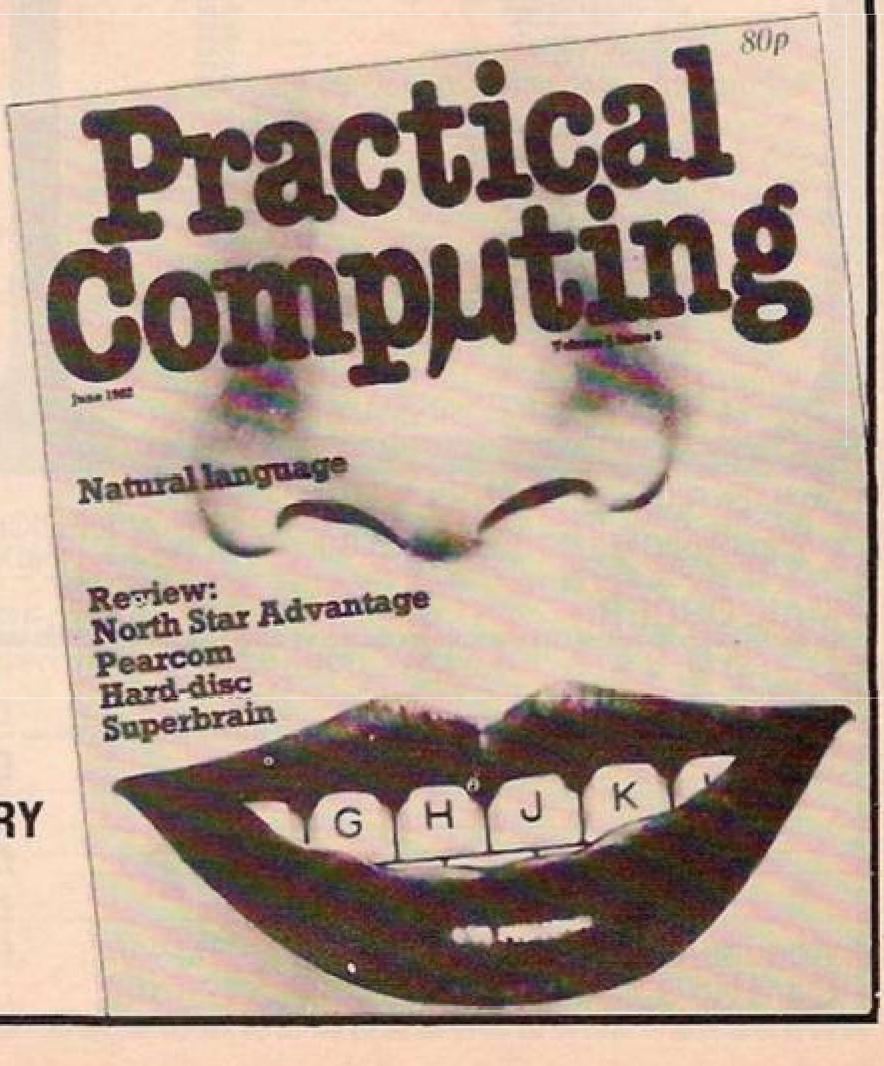
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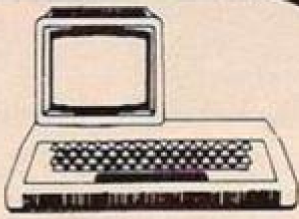
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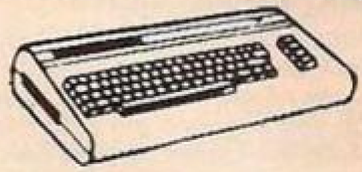
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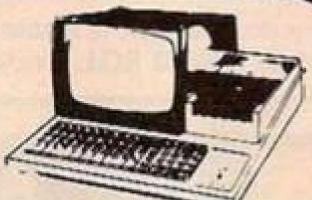
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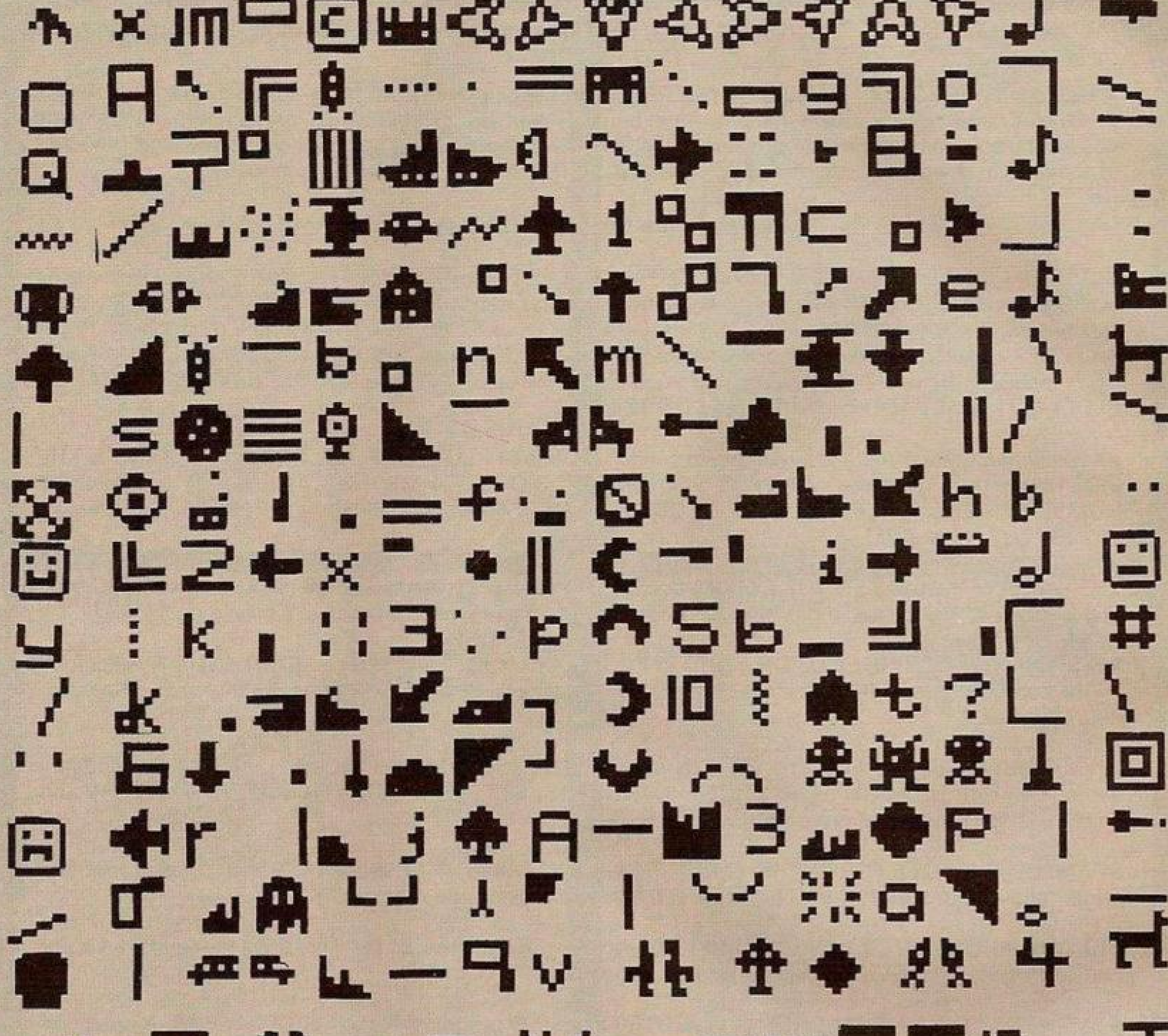
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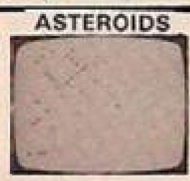
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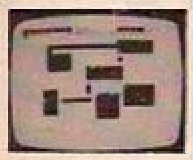
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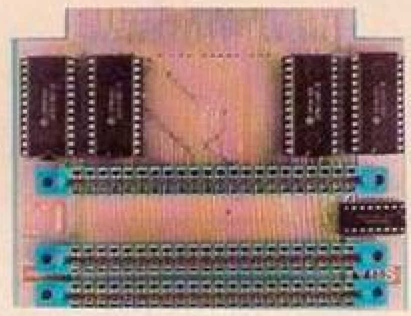
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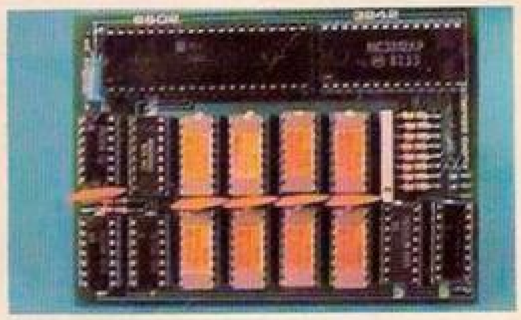
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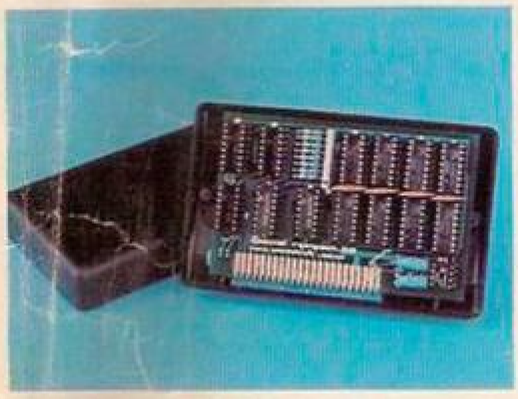




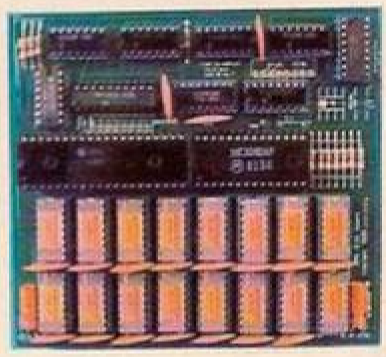
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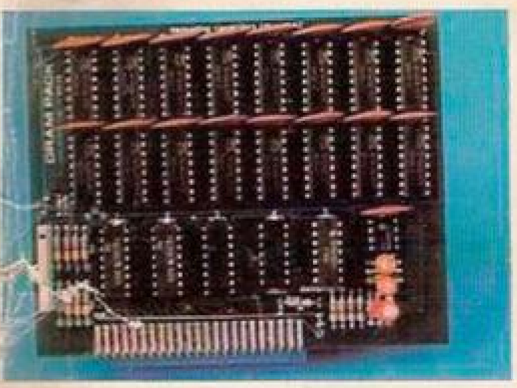


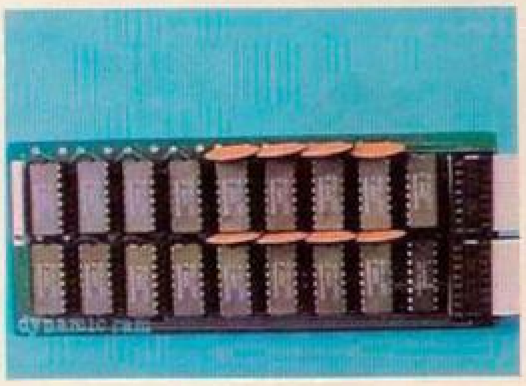


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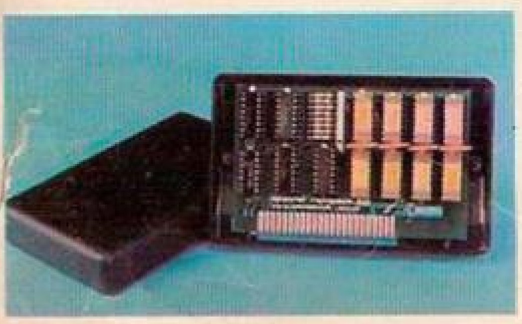


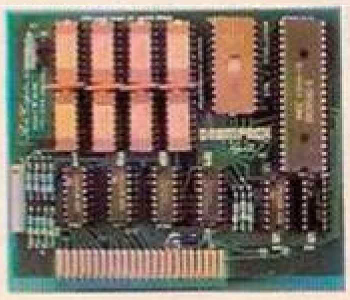


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